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MICROFILM ABSTRACTS

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MICROFILM ABSTRACTS

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INTRODUCTION

In the past this publication has been devoted exclusively to abstracts of doctoral dissertations, available in complete form as microfilm or paper enlargements. Volume VI Number 2 initiated a departure from this policy; the inclusion of abstracts of longer monographs of merit, in addition to dissertations.

The same conditions warranting microfilm publication of dissertations, namely size, expense of publishing through ordinary channels, delay in publication, and a limited but nonetheless important demand for copies, apply equally well to certain monographs of a specialized nature. Accordingly this and future issues will be divided into three sections instead of two, as in the past: 1) Abstracts of doctoral dissertations; 2) Abstracts of monographs (not dissertations); and, 3) A cumulative index of titles abstracted in preceding issues of Microfilm Abstracts.

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Eugene Power

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Part I

DISSERTATIONS

ART

IONIC CHITON-CLAD MAIDENS OF THE FIFTH CENTURY

Cleta Olmstead Robbins, Thesis (Ph.D.)
Bryn Mawr, 1942

"Ionic Chiton Clad Maidens of the Fifth Century" is an attempt to ascertain fundamental criteria by which conclusions on classical sculpture can be definitely provable. It is specifically a study of drapery, further limited to the one form--of the Chiton--though it necessarily utilizes other forms and factors whenever demonstrable similarities demand their inclusion. The preface surveys the past contributions to this field of knowledge, notes the numerous and various types of divergent opinions, and explains, whenever possible, the resultant disagreements among scholars. The difficulties peculiar to a study of Greek sculpture are enumerated, and methods applicable to a study of Greek sculpture are suggested. Style in art, and particularly stylistic criticism, are defined according to the visual approach. The three primary divisions of style--the chronological, the local, and the personal--are discussed in relationship to the history of art in other periods. Because the chronological criteria apply to all fifth century art, the stylistic development according to red-figured vases is first examined. The Introduction--a brief historical outline and a summary of the literary references--is the background for the division into chapters under regional headings, Ionia, Attica, the Empire, and Magna Graecia.

Based on the classical fragments from Ephesos, attributions are made to Ionia, such as the sculptures from the Tholos at Delphi and the reliefs by Master C on the Nikė parapet. The characteristics which once caused the Doria--Pamfili Cybele to be

rejected are explained as optical corrections, and the original is assigned to Northern Greece. Related to it are the Hertz bend, the Nikė of Paionios, the Ince-Blundell Apollo, Master B of the Nikė parapet, and a troublesome series of Muses. The present condition of each, the date of the copy, and the exactness of the relationship are all noted, as well as the evidence for the localization.

While the Ionic drapery is described as "ribbed", and the northern as "pouched", the Athenian is divided into two classifications, the "stringy" and the "chiseled or chamfered", both particularly characteristic of the Parthenon sculptures. To the former group are assigned the Kore Albani, a fragmentary Artemis in the Vatican, the Aphrodite of Gortyn, and Master E of the Nikė parapet. The latter group, characterized by the "chiseled" or "chamfered" drapery, includes the Niobids in Copenhagen, Master A of the Nikė parapet, and the Hera Barberini. The difficulties in the customary approach to the Eleusis relief of Demeter, Kore and Triptolemos are pointed out.

Western Greek sculpture, described as "linear", is discussed from the early fifth century (Harpy Monument), predominantly Ionic, to the late fifth century (Montecompatri statue in Berlin), predominantly Attic. Locrian terracottas demonstrate the local development when dated according to Attic red figured vases. One type of Chiton, labeled "snakey", remains unlocalized, while another, called "pleated" can only be named semi-Ionic. To the latter belong statues with copies in Corinth and the so-called Aspasia type.

In conclusion "the history of classical art is yet to be written: records of all statues must be investigated in the documentary sources, copies must be more accurately dated, and the study must be completed finally, not with photographs or casts but from the originals themselves. Undoubtedly some of the theories here advanced will eventually have to

be discarded: yet the fact that out of a mass of conflicting opinion, some sort of unity of date, locale, and authorship has been possible, if only tentatively so, is heartening for future research. Since many of the famous sculptors are known by single works, it does not seem impossible to hope that in the Utopia of the future their personalities can be uncovered."

In the Appendix the various local styles are shown to have continued from the late fifth century into the fourth, thus proving the validity of the various native traditions. The footnotes include all pertinent material, such as origin, restoration, size, and condition. The thesis is copiously illustrated, inasmuch as the basic proof is visual; the text enumerates the points of comparison and why they, rather than the dissimilarities, are fundamental. No attempt is made to discuss all famous examples of classical art; rather only those statues which prove themselves related, are included. It is to be hoped with such a direct and theoretical approach, uninspired and detailed analysis, careful and general observation, the greatness of Greek sculpture can be more accurately examined, better understood, and more perfectly visualized in the future.

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BACTERIOLOGY

STUDIES IN BACTERIAL NUTRITION WITH SPECIAL REFERENCE TO CLOSTRIDIUM SORDELLII

Henry Dirk Piersma, Thesis (Ph.D.)
Purdue University, 1941

An investigation of the nutritional requirements of one of the members of the gas gangrene group of bacteria, Clostridium sordellii, was undertaken in an effort to produce the toxin elaborated by this organism in a synthetic medium. At the time this work was initiated, no attempt had been previously made to grow this anaerobe in a medium of known composition. The results obtained in this study represent the first report of the successful cultivation of Clostridium sordellii in a chemically defined medium.

A basal medium was constructed containing gelatin hydrolysate, potassium dihydrogen phosphate, certain amino acids, glucose, minerals, and a reducing agent. In this medium growth failed to take place without the presence of certain growth factors, which were identified as Vitamin B_1, Vitamin B_6, pantothenic acid, and nicotinamide. The optimal concentration of these substances for growth in the described basal medium was found to be 1.0 microgram per milliliter for Vitamin B_1, Vitamin B_6, and pantothenic acid, and 2.5 micrograms for nicotinamide.

The essential nature of these growth factors for Clostridium sordellii was confirmed by an examination of three other strains of this organism. It was found that these also required the same complex chemical substances found essential to that strain employed in the original work. It is suggested, therefore, that possibly all strains of this pathogen require Vitamin B_1, Vitamin B_6, pantothenic acid, and nicotinamide for normal growth.

The effect of the presence of biotin in the basal medium was investigated, and it was observed that certain biotin-containing preparations were able to stimulate further development of this species. However, the methyl ester of biotin was unable to improve growth under the described experimental conditions. Several other compounds, some of which are known to be important in the nutrition of other bacteria, were found to be non-essential for Clostridium sordellii. These substances included uracil, para-amino benzoic acid, Vitamin B_2, choline, glutamine, pimelic acid, creatine, cadaverine, and betaine. An alcohol soluble fraction of liver extract was found to stimulate the growth of this organism, which demonstrates that additional factors are required for development in the synthetic medium.

In an attempt to construct an amino acid mixture to substitute for the gelatin hydrolysate, certain amino acids were found to be more essential than others. Among those exerting the most pronounced influence were d-alanine, d-glutamic acid, and l-cystine.

An experiment was carried out to determine the extent of toxin production in the synthetic broth, and it was noted that practically no toxin was elaborated in the medium of known composition. It is apparent that additional factors are important for the formation of toxin in this medium.

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BIOGRAPHY, CLASSICAL

THE HERAKLIDS

Jessie Winifred Alston, Thesis (Ph.D.)
Bryn Mawr, 1941

Inspired by the findings of recent research into certain aspects of Greek mythology, the conviction that elements of historical fact underlie many traditions long labelled mythical led to this investigation into the so-called "Myth of the Heraklids". Considering Herakles himself, rather than his descendants, the crux of our inquiry, as the desire to regain a kingdom denied to their ancestor prompted the Heraklids to invade the Peloponnesos, we examined first Herakles' apparently dual nature of man-hero and faded god. His Labours and other adventures fell mainly into three categories, embracing floating legends applicable to other heroes, possible reflections of historical events, and suggestions of an aspect peculiar to Herakles alone. An examination of this last, most promising line of inquiry indicated that Herakles had been originally an Asia Minor divinity, with recognizable attributes, filling perhaps the role of consort to the Great Mother. It remained to discover how and when the knowledge of Herakles in this form had reached the mainland of Greece, why such divine indications had later gone unrecognized or become obscured, and whence had arisen the man-hero aspect which, from Homer to Diodorus, dominated the Greek conception of Herakles. The events in the story of the capture of Oichalia suggested a possible connection between the Lydian Omphale, Herakles' mistress, a type of the Asiatic Greek Mother, and the Greek state of Trachis, where, on Mount Oita, Herakles' body had been burned. Further investigation of Trachinian legend revealed

promising testimony to an association between the divine Herakles and this area. The traditional stories of the "Deianeira" cycle and the tales of Herakles' adventures with the Dryopians suggested that Herakles was once regarded by the Dryopians as a god, connected with the worship of Demeter-Ge until the victorious Apollo-worshippers converted them to a new religion. The fact, however, that the Dryopians were not Asiatics but an early wave of South Aeolian Greeks, posed the question, when and how did they come into contact with Herakles-worshippers? Certain signs indicating that the Herakles-worshippers were there first, and others pointing to old settlements of this folk in other than Trachinian sites, prompted an investigation into the so-called Pelasgians, especially in such centres as Attica, where Herakles too had close connections. We concluded that the Asia-Minor provenance of the Pelasgians, the antiquity of the pre-Greek Herakles-worship in Trachis and Delphi, and the traces of it remaining in such places as Argos, Attica and the North Aegean, probable Pelasgian settlements, implied that the Pelasgians were a possible source of that pre-Hellenic Herakles-worship transmitted early to the Dryopian Greeks. Successive waves of Greek invaders, flooding central and southern Greece in the wake of the South Aeolians, were responsible for the ultimate submergence of Herakles' worship (symbolized by the subservience of Herakles to Eurystheus), supplanting it even in Dryopia by the worship of Apollo. Eventually the Dryopians, forced by the increasing pressure, joined the latest comers and sought new homes in the Peloponnesos. So their names were coupled irrevocably with those of the Dorian invaders. At the same time Herakles, who had long been undergoing a transformation from a god, whose worship was dying out everywhere, to a hero linked by North Aeolian bards with the historic deeds of Thracians and Ionians, was recognized by the Dorians as a heritage of their fellow immigrants and

eventually adopted as their own patron deity. By a process of accretion the aggregate of things Heraklean finally became immense.

We then approached the question of the origin and nature of the Heraklids with most of our problems solved. The Heraklids were Dryopians, former worshippers of Herakles, driven from their homes into the Peloponnesos about the same time as the Dorians entered southern Greece. Their entry was wrongly termed a 'Return' but in other respects the legend contained elements of historical truth. Their share in the migration won them the reputation of leaders of the Dorians, shortlived, as the history of each of the three Dorian dynasties shows early breaks in the royal lines. Finally, though it aroused interesting speculation, an examination of legends concerning other Heraklids, such as Telephos and Thessalos, produced no compelling evidence attesting their connection with the Heraklids of the Return.

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BIOLOGICAL CHEMISTRY

THE HYDROLYSIS OF CASEIN BY ENZYMES WITH ESPECIAL REFERENCE TO THE DISTRIBUTION OF AMINO ACIDS IN THE HYDROLYSATE

John Beck, Thesis (Ph.D.)
Purdue University, 1937

In order to gain a greater insight into the structure of proteins as affecting the relative availability of various amino acids for animal nutrition, a study was made of the hydrolysis of casein by proteolytic enzymes with special reference to the liberation of specific amino acids.

A comparative study was made of the rates of unmasking or liberation of four amino acids--tyrosine, tryptophane, histidine and arginine--in relation to one another, and to the general hydrolysis of casein.

Hydrolysis of casein by pancreatin takes place very rapidly during the first six hours. Although most of the hydrolysis occurs during the first twelve hours, some hydrolysis is noticed even after seventy-two hours which continues to proceed slowly for many days. When pancreatin is used to hydrolyze casein, 34 per cent of the peptide groups remain unattacked after seventy-two hours.

The linkages of some amino acids are more liable to enzymatic hydrolysis than others with pancreatin or yeast proteases.

Tyrosine was found to be unmasked much faster than general hydrolysis proceeds. Thus, when 90 per cent of the tyrosine has been unmasked, only 12 per cent of the peptide linkages have been split.

Tryptophane, under the same conditions, was unmasked slightly slower, being finally liberated to the extent of 85 per cent.

A new method for the determination of the rate of liberation of the basic amino acids, arginine and histidine, has been developed. These amino acids are separated from the products of enzyme hydrolysis by means of electrodialysis and subsequently determined. By this method, it has been shown that arginine and histidine are liberated more slowly than tyrosine or tryptophane. After prolonged digestion, only two-thirds of the arginine was liberated while histidine was liberated almost completely. This is the first time that the rate of liberation of histidine by enzymes has been determined.

Yeast proteases, applied for the first time to studies on the rate of liberation of amino acids in proteins, appear to act similarly to pancreatin in unmasking tyrosine, but fails to unmask tryptophane as completely as pancreatin.

These studies indicate that tyrosine occurs in the protein molecule in such positions and combined through such linkages as to be readily liberated by proteases; tryptophane appears to be in two types of combinations, one of which is easily hydrolyzed by proteolytic enzymes of either pancreatin or yeast, while the other is resistant to yeast proteases but attacked by pancreatin; arginine is combined in at least two types of combinations, one of which is highly resistant to enzymatic hydrolysis by pancreatin; and, histidine is combined apparently in one type of combination which is more resistant to hydrolysis than the tyrosine or tryptophane combination.

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A STUDY OF THE FAT COMPOSITION AND FIRMNESS OF PORK UNDER VARIOUS DIETARY CONDITIONS

Winfred Quentin Braun, Thesis (Ph.D.)
Purdue University, 1942

The hog industry is based on corn, but corn alone is nutritionally deficient and therefore swine raisers supplement their rations with locally available protein feeds which will give them the most economical returns. Some of these supplements, especially soybeans, peanuts and linseed oil meal, contain oils which tend to produce soft depot fats in pigs. This is a matter of concern both to the hog producer and processor, for consumers often object to the appearance of pork containing soft fat. In addition, a lack of uniformity in the firmness of pork fats complicates the manufacture of consistently high-quality lard.

In the soft pork study reported here the kind and quality of fat produced by hogs at different levels of growth under various dietary conditions were determined. Twenty-five pigs weighing approximately 60 pounds each were divided into five equal lots. The control group received 86 per cent corn, 12 per cent soybean oil meal and 2 per cent mineral mixture, the fat content being 3.56 per cent. The second group received 81 per cent corn, 12 per cent soybean oil meal, 2 per cent mineral mixture and 5 per cent beef fat. The third group received 81 per cent corn, 12 per cent soybean oil meal, 2 per cent mineral mixture and 5 per cent soybean oil. The fourth group received 81 per cent corn, 12 per cent soybean oil meal, 2 per cent mineral mixture and 5 per cent corn oil. The fifth group received 76 per cent corn, 12 per cent soybean oil meal, 2 per cent mineral mixture, 5 per cent beef fat and 5 per cent soybean oil. One animal from each group was slaughtered when

the average weights were approximately 100, 135, 170, 200, and 250 pounds. The carcasses were graded and measured, and fat samples were removed for chemical analyses.

The component fatty acids of the back fats of ten animals were determined by fractional distillation of the methyl esters of the fatty acids obtained from the fats. The saponification equivalents, iodine values and the saturated acid percentages of the distillate fractions were determined, and after the identity of the acids present in the different fractions had been established, these values were used for the calculation of the component fatty acid compositions. Oleic, linoleic, stearic, palmitic, palmitoleic, myristic and arachidonic acids were found to be present in all the samples analyzed, and there were indications of the presence of traces of tetradecenoic acid. Linolenic was not detected.

It was found that rations which were nutritionally adequate were essentially equivalent in growth-producing efficiency when they contained 3.5, 8 or 13 per cent of not too high melting fat, the average gains being from 0.30 to 0.32 pounds per pound of ingested food. Animals receiving 5 per cent of beef fat and 3 per cent corn oil in their rations gained an average of 0.26 pounds per pound of food.

Rations containing 3.5 per cent of corn oil, which is approximately the amount usually found in the corn and tankage or soybean oil meal rations, produced satisfactorily firm pork, but they did not produce as thick layers of subcutaneous fat as the rations containing 8 to 13 per cent of fat. The addition of 5 per cent of beef fat to a ration containing 3.5 per cent of corn oil caused a slight hardening of the body fat by increasing the storage of stearic acid and repressing the storage of linoleic acid. Addition of 5 per cent beef fat to a ration containing 5 per cent soybean oil and 3.5 per cent corn oil did not produce firm fat. The evidence indicated that the softening effect of soybean oil was due to

an increase in the linoleic acid content and a decrease in the palmitic acid content of the body fats. The animals receiving rations tending to produce soft pork had soft fat at 100 pounds weight, but there was a slight increase in firmness as the animals reached 250 pounds weight.

Linoleic acid from the soybean oil was very readily assimilated and stored by the pigs, whereas beef fat, which has a high saturated fatty acid content, did not greatly increase the saturated fatty acid content of the depot fat. Arachidonic acid was present in small amounts in all the samples of fats analyzed.

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METABOLISM OF CREATINE

Alice Watson Kramer, Thesis (Ph.D.)
Purdue University, 1935

It has been found difficult to change the creatine concentration of the muscle.

The administration of sodium fluoride resulted in an increase in muscle creatine.

The administration of a diet low in protein alternately with a complete diet resulted in a decrease in muscle creatine.

With the administration of phosphorus, the further administration of creatine, glycine, or of sodium glutamate did, whereas the administration of arginine or alanine did not result in an increase in muscle creatine.

These experiments support the view that glycine or glutamic acid are concerned with, whereas arginine or alanine are not directly concerned with creatine formation in the muscle of rats.

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THE FORMATION OF GLYCOGEN IN THE LIVER OF THE WHITE RAT FOLLOWING THE ADMINISTRATION OF CERTAIN SYNTHETIC ORGANIC ACIDS

Mary Louise Lyons, Thesis (Ph.D.)
Purdue University, 1941

The formation of glycogen in the liver of the white rat after the normal store had been depleted by a twenty-four hour period of fasting was used as a measure of the glucogenetic abilities of certain organic acids.

Glucose formation was observed following the administration of both the racemic mixtures and the separate isomers of 2-amino-butanoic acid and 2-aminohexanoic acid and of dl-2-aminooctanoic acid. These results may be explained by assuming that each amino acid was oxidatively deaminated and decarboxylated to form the aldehyde containing one less carbon atom than the original acid, and that this compound was then oxidized to the corresponding fatty acid. Since there was no appreciable difference in the results which were obtained with the d(-) and the l(+) forms of the 2-amino acids containing four or six carbon atoms in a straight chain, there must be either an inversion of the d(-) isomer in each case or a utilization of the unnatural isomer without inversion. It is probable that when the carbon atom adjacent to that which holds the amino group has two hydrogen atoms attached to it, there is no interference with deamination even though the configuration of the asymmetric carbon atom is not that of the naturally occurring form. The occasional deposition of glycogen following the feeding of dl-2-aminopentanoic acid was found to be caused by the l(+) form of the compound; the ingestion of the

d(-) isomer resulted in uniformly low glycogen levels, while the ingestion of the l(+) isomer produced a marked increase in some of the experiments in which it was fed. It is suggested that there occurred a stimulation of glucose synthesis from other compounds and not a conversion of the l(+)-2-aminopentanoic acid itself to glucose.

The occurrence of glucogenesis when the natural l(+) isomer of 2-amino-3-methylpentanoic acid was fed and the failure of glucogenesis to occur when the d(-) form was fed indicates that the presence of a methyl group on the carbon atom adjacent to that which holds the amino group interferes with the process of deamination only when the configuration of the asymmetric carbon atom is that of the unnatural isomer. A series of reactions similar to those which were proposed for the straight chain 2-amino acids cannot take place in the metabolism of this compound because 2-methylbutanoic acid, which would be an intermediate, was found to be non-glucogenetic. A possible alternative is the simultaneous oxidation of the methyl group and the removal of the amino group followed by a splitting of the molecule to form a derivative of 1,4-butanedioic acid.

The feeding of 2-amino-2-methylpropanoic acid caused the deposition of glycogen in the livers of only a portion of the animals which received the compound. Since the carbon atom to which the amino group is attached holds two alkyl groups, it would be expected that deamination of the compound would be difficult. Probably the amino acid does not form glucose, but it does cause the synthesis of glucose from precursors which are already present within the animal.

dl-3-Aminobutanoic acid produced extremely high glucogen levels; in view of the ketogenic nature of the hydroxy and keto analogs neither hydrolytic nor oxidative deamination of the amino acid is a possible reaction. Either omega oxidation to form 2-amino-1, 4-butanedioic acid or deamination to form 3-butanoic

acid followed by a fission of the molecule to produce an acid containing three carbon atoms may represent the first steps in the metabolism of the compound.

The production of glucose from 5-aminopentanoic acid suggests that propanedioic acid, which could be formed by oxidative deamination and subsequent beta oxidation, may be an intermediate in the glucose formation. Analogous reactions cannot be proposed for the metabolism of 6-aminohexanoic acid because such reactions would result in the production of 1,4-butanedioic acid. The latter compound is glucogenetic, but 6-aminohexanoic acid was found not to form glucose.

The failure of both dl-3-methylpentanoic acid and 4-methylpentanoic acid to cause the production of liver glycogen indicates that neither fatty acid is demethylated in the animal body; the pentanoic acid which would be so formed would give rise to glucose.

A limited number of experiments which were performed with dl-2-hydroxy-1, 5-pentanedioic acid showed no conversion of the compound to glucose. Since 2-keto-1,5-pentanedioic acid is known to form glucose, the in vivo oxidation of the hydroxy group evidently does not proceed readily.

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THE INFLUENCE OF STRUCTURAL CONFIGURATION ON THE DEAMINATION OF AMINO ACIDS IN THE NORMAL RAT

Morris Franklin Milligan, Thesis (Ph. D.)
Purdue University, 1942

Optically active amino acids were administered orally to albino rats excreting constant amounts of urinary nitrogen; the distribution of the extra urinary nitrogen was determined. The nitrogen of l(+) isoleucine, l(+) alloisoleucine, d(+) leucine, l(-)leucine, d(-)norleucine, l(+)norleucine, l(+) valine, l(+)α-amino-phenylacetic acid, and d(-)α-amino-phenylacetic acid appeared in the urine as extra urea and ammonia. That of d(-)isoleucine, d(-) alloisoleucine, d(-)valine, d(-)pseudoleucine, and l(+)pseudoleucine appeared in the urine largely as amino acid nitrogen.

It is concluded that: a.) the presence of a substituent methyl group on the beta carbon atom interferes with the deamination of amino acids of the d- series but has no effect on the deamination of their enantiomorphs; b.) the presence of two substituent methyl groups on the beta carbon interferes with the deamination of amino acids of both series; and c.)α-amino-phenylacetic acid does not conform to the previous generalizations, either form being metabolized by the albino rat.

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THE INFLUENCE OF CERTAIN DIETARY FACTORS ON THE PRODUCTION OF DENTAL CARIES IN A SUSCEPTIBLE STRAIN OF RATS

Kenneth Jean Olson, Thesis (Ph.D.)
Michigan State College, 1947

A Caries susceptible strain of white rats was used to study the influence of fluoride, sucrose, evaporated milk and powdered whole milk on the # production of dental caries. Carious lesions were observed in the living animal and the progress was recorded at two week intervals until a severe stage developed.

Fluorides were administered by supplementing a moderately Cariogenic fine rice ration with 125 p.p.m. NaF and feeding the ration ad libilum. Prenatal effects were studied by feeding the fluoride supplemented ration to the maternal rats and dividing the litters into two groups at birth, one group being transferred to a mother fed the basal ration and the other remaining with the original mother. A similar procedure was followed to investigate the effects of fluoride during the lactation period. In this study susceptible litter matings were fed the basal fine rice ration and the offspring divided at birth and treated as explained above. To study the postweaning effects of fluoride, offspring were maintained on the fluoride supplemented ration until weaned and then divided into two groups. One group remained on the fluorine supplement whereas the other was fed the fine rice basal ration. Results show that fluorides fed to the maternal animal during the phases of pregnancy and lactation have no caries inhibiting effects on the offspring. Animals suckled by mothers fed the fluoride supplemented ration and continued on the same diet after weaning show marked resistance to dental caries.

Caries susceptible rats fed an essentially fermentable CHO-free ration containing alfalfa, casein and lard remain free of caries indefinitely. Animals kept caries-free for a year on this ration will develop caries when changed to a fine rice cariogenic ration although the initiation time is somewhat longer than in the case of weanlings.

A ration containing 50% sucrose consistently produced caries in the susceptible strain of rats although the initiation time was markedly longer than that of control animals fed a fine rice ration. A two week exposure of susceptible rats to a fine rice ration significantly enhanced the cariogenic nature of the sucrose ration.

Milk in two forms was fed to the caries susceptible rats. A ration containing 79% powdered whole milk, alfalfa, and sodium chloride failed to produce caries when fed over a period of 160 days. Common brands of evaporated milk either with or without 10% sucrose when fed as the only source of nutrient produced no caries over a period of 190 days.

It was observed in the caries susceptible strain of rats that even though the initiation time could be varied markedly under controlled dietary conditions the progress of caries from an initial to a severe state was practically the same.

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THE EFFECTS OF VARIOUS SOURCES OF VITAMIN D AND DIHYDROTACHYSTEROL ON THE BLOOD CALCIUM AND PHOSPHORUS LEVELS IN COWS, DOGS, CHICKENS, AND RATS

Benjamin Hartley Pringle, Thesis (Ph.D.)
Michigan State College, 1947

Comparisons between pure Vitamin D, certain natural Vitamin D products, and dihydrotachysterol were made to determine whether there is a difference in physiological behavior between the natural and pure products.

Chickens, albino rats, cows, and dogs were used as experimental animals in these studies.

The blood picture was studied to determine the effects of the various products used. Because of the fact that Vitamin D is chiefly concerned with calcium and phosphorus metabolism, a detailed study was made of the phosphorus and calcium changes of the blood accompanying the administration of the various products. In addition some of the experiments involved the determination of the acid and alkaline phosphatase level in the blood.

It was found that rats fed massive doses of Vitamin D from various sources showed characteristic resistance to blood calcium changes. Dogs fed massive doses of various Vitamin D products were observed to show a hypercalcemia and in certain cases a general emaciated condition followed by death. Autopsy showed a general calcification of various tissues. Chickens administered varying doses of Vitamin D products showed lower rises with Vitamin D_2 than with Vitamin D_3. Vitamin D_3 was found to be about 36 times more effective than Vitamin D_2. Massive doses of various Vitamin D products administered to cows caused a definite hypercalcemia. On the basis of limited studies, it would appear that

irradiated yeast or an extract of irradiated yeast was somewhat more effective than a corresponding amount of purified Vitamin D.

Dihydrotachysterol produced significant blood calcium elevations in young and mature rats fed normal and low phosphorus diets. The average blood calcium rise exhibited by dogs on dihydrotachysterol supplements of 1 mgm., .5 mgm., and .25 mgm. per kg. of body weight were 8.6 mgms., 5.1 mgms., and 1.1 mgms. respectively. Chickens fed supplements of dihydrotachysterol were observed to show calcium rises of 8.6 mgms., 5.1 mgms., and 1.3 mgms. respectively for the same levels as administered to dogs. Dihydrotachysterol on a .5 mgm. level produced a 5.0 mgm. blood calcium rise in cows. These effects are comparable to those obtained with dogs and chickens.

Dogs administered massive doses of various Vitamin D products were observed to attain blood phosphorus rises of between 1.4 and 2.6 mgms. Young and mature chickens were observed to show significant blood phosphorus elevations when fed massive doses of various Vitamin D products. Here again Vitamin D_3 was found to be more effective than D_2. Cows fed supplements of various Vitamin D products in massive doses produced marked blood phosphorus rises varying from 2 to 3 mgms.

Young and mature rats fed normal and low phosphorus diets were shown to have elevated blood phosphorus levels when various doses of dihydrotachysterol were administered. The rises were greatest in the case of the normal ration. Dogs to which dihydrotachysterol was administered showed phosphorus elevations of 2.53 mgms., 1.75 mgms., and 1.05 mgms. at levels of 1.0 mgm., .5 mgm., and .25 mgm. per 10 kgm. body weight respectively. Chickens administered supplements of dihydrotachysterol showed blood phosphorus increases at all levels used. The rises were somewhat higher in the males than in the females. Cows fed dihydrotachysterol on a basis

.5 mgm. per 10 kgm. of body weight showed an average phosphorus rise of 2.04 mgms.

Acid and alkaline serum phosphatase values on rats fed 1,000 to 20,000 unit levels of Vitamin D (I.E.) per 10 kgm. body weight were shown to be significantly lowered. Normal and low calcium rations were used. The low calcium ration gave higher initial and final values in these studies. Serum phosphatase values on cows fed dihydrotachysterol showed a gradual decline in the alkaline phosphatase values whereas the acid phosphatase remained unchanged.

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CATABOLISM OF FATTY ACIDS

John T. Tripp, Thesis (Ph.D.)
Purdue University, 1936

Part I

The Metabolism of Phenyl-Stearic Acid

A mixture of 9 and 10 phenyl-stearic acid, prepared according to the method of Nicolet and De Milt, was incorporated in a complete diet and administered to dogs and white rats. The daily urines were preserved with toluene in a refrigerator and pooled at the end of the feeding period. The experimental and a normal urine were concentrated under reduced pressure, and separately extracted with ether and then with petroleum ether when the concentrate was acid, neutral and alkaline.

Aliquots of all of the fractions were oxidized by refluxing with $KMnO_4$ and also with fuming HNO_3 to convert aromatic compounds to a mixture of ortho and para nitro-benzoic acids. The extracts were decolorized with norite and the extractant allowed to evaporate spontaneously. No difference could be found between the substances isolated from the experimental and control urines by either chemical or physical means. Some of the fractions that yielded considerable nitro-benzoic acids on oxidation were treated with p-amino-azo-benzene according to the method of Mazume and Kiro but did not yield any solid derivatives. Benzoylacetic acid and acetophenone could not be detected by the tests described by Dakin.

Phenyl-stearic acid was administered to 3 rabbits by intravenous injections. Two of the rabbits died within 5 and 9 hours, respectively, apparently of respiratory failure. Post mortem examination showed no changes in any of the tissues except the

lungs, which were filled with blood clots and serous fluid. The lungs were ground and extracted with ether but the extracts did not yield any phenyl-stearic acid or its degradation products.

The third rabbit survived without exhibiting signs of any harmful effects. The urine obtained was oxidized, but it did not yield any more nitro-benzoic acids than did the urine from normal rabbits.

Part II

Feeding of Brominated Fats

Inasmuch as it proved difficult to follow the metabolism of the fatty acids with the phenyl group as a marker, it seemed desirable to use something else that could be more readily identified. Attention was turned to the brominated compounds, because it was felt that it might be possible to identify compounds containing bromine. Since so little was known about the distribution of bromine in the tissues, an integral part of the work was the determination of that distribution in normal animals and following the ingestion of brominated compounds.

Eight white rats were kept on a complete diet having part of the butter fat replaced with tetra-bromo-stearic acid. The addition of $NaHCO_3$ in amounts equivalent to the bromine content enabled the animals to grow and gain weight. At the end of eight weeks the urines were leached with water, from the filter papers on which they had been absorbed. The leachings were concentrated under reduced pressure and extracted in a continuous extractor with ether, and then with petroleum ether when the concentrate was acid, neutral and alkaline.

The ether extract of the acid and neutral material was found to contain the organic bromine present in the urine. The petroleum ether did not contain more than a trace of Br. This treatment yielded a number of fractions containing as much as 100 mg. of

organic Br, but there was, in addition to this, about 10 gm. of a mixture of other organic substances. From the complexity of the mixtures obtained it was evident that a large amount of the organic bromine should be available if a successful isolation of this possible intermediate was to be made.

Twenty-one liters of human urine were collected following the ingestion of 120 gm. of tetra-bromo-stearic acid dissolved in olive oil. No harmful effects were noted by either of the two laboratory workers who ingested the tetra-bromo-stearic acid. The organic Br was extracted from the pooled human urines in the same manner as the rat urines. The various fractions were allowed to crystallize and were purified by repeated fractional crystallization. Further attempts at purification were made by treatment with Ca, Ba, Hg, Fe, Cu, Zn and Pb salts and oxides, but all of the methods used failed to isolate the organic bromine compound in the urine. Escher's procedure for preparing derivatives of brominated acids with p-amino-azo-benzene did not remove the Br from the fractions.

Part III

Bromine Distribution

The failure to isolate any intermediates from the urine led to the study of Br distribution following the ingestion of fatty acids with the hope of throwing light on the metabolism of these compounds.

Four diets containing different Br compounds were fed to white rats. In a few days the animals refused the food containing di-bromo-behenic acid and di-bromo-stearic acid so the same basal ration was given them, but the fat and fatty acid were melted together and administered with a medicine dropper. $NaHCO_3$ was given in an amount equivalent to the bromine intake, to prevent acidosis. The animals maintained their weight during the experimental period.

At the end of the feeding period, the animals were electrocuted, bled at once and then dissected. Each tissue removed for analysis was transferred to a weighed stoppered flask and prepared for analysis by the method of Barbour. The total fatty acids were determined by the method of Leathes and Raper.

For the analysis, aliquots of the tissue solutions were freed of organic matter by the method of Behr, Palmer and Clark. The bromine analyses were made by the method of Newton and Newton.

The extracted fat was fused in a Parr bomb and found to contain bromine. The presence of an organic compound in the fat was confirmed by refluxing normal rat fat, tetra-bromo-stearic acid, and the fat of animals on the experimental diets with an alcoholic solution of $AgNO_3$. No reaction resulted with the normal rat fat but the tetra-bromo-stearic acid and experimental rat fat gave a precipitate that proved to be AgBr.

A distribution study was made to account for the bromine administered to two of the animals that died of acidosis before the end of the experimental period. The results of these analyses are recorded in Table 2. The Br content of the tissues analyzed separately are recorded in Tables 4, 5, 6 and 7.

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THE AVAILABILITY TO THE RAT OF CERTAIN CAROTENES IN RAW AND COOKED VEGETABLES

Marion A. Wharton, Thesis (Ph.D.)
Michigan State College, 1947

Carotenes were studied under the following headings; 1. the alpha- and beta-carotene content of raw, cooked and frozen spinach and carrots. 2. the relative value of alpha- and beta-carotene, vitamin A alcohol, raw and cooked spinach and carrots for growth of the rat. 3. the fecal excretion and absorption of various carotenes and storage as vitamin A in the liver of the rat.

Spinach and carrots, purchased in the local market were analyzed spectrographically for total carotenes and alpha- and beta-carotene in the raw and cooked state and at various periods of frozen storage. Weanling rats on a vitamin A free ration were fed beta-carotene, alpha-carotene, vitamin A alcohol and raw and cooked spinach and carrots at various levels of intake for a 28-day period. The growth response, fecal excretion, absorption and liver storage of vitamin A were studied.

The total carotene content of raw spinach was 4.19 and 5.96 mg. per 100 g. of vegetable, carrots, 14.00 and 10.53 mg. for vegetables purchased in May and November respectively. The percentage beta-carotene was 76.4 and 81.6 for raw spinach and 66.2 and 76.4 for raw carrot respectively. Cooked spinach contained 6.33 and 6.92 mg. total carotene and cooked carrot 12.79 and 9.64 mg. per 100 g. of vegetable with a beta-carotene content of 86.5 and 94.1 for cooked spinach and 58.6 and 62.3 for cooked carrot. Frozen storage resulted in little change in total carotene content of either raw spinach or carrots in three months but losses up to 50 per cent

occurred after 15 months storage. There was little change due to storage in total carotenes of the cooked product. Absorption spectra are presented for alpha- and beta-carotene in cyclohexane and for extracts of the raw and cooked spinach and carrots and these products after 10 months frozen storage. Cooking produced some change in the absorption curves but frozen storage, of the raw products, for 10 months, caused a marked change in the absorption curves, indicating isomerization. The change in the cooked products was less significant, indicating that cooking stabilized the carotene content.

In the growth study of weanling rats, when all sources of vitamin A are calculated to micrograms of beta-carotene from the beta-carotene growth response curve, the ratio of beta-carotene to vitamin A alcohol, alpha-carotene, the total carotenes of raw spinach, cooked spinach, raw carrot and cooked carrot for male rats are 1.00: 0.45: 2.03: 2.08: 2.25: 3.18: 2.56 respectively and for female rats 1.00: 0.72: 5.90: 3.29: 3.64: 6.47: 3.29 micrograms of beta-carotene respectively.

The percentage carotene absorbed ranged from 61 to 91 but there was little difference between beta-carotene, alpha-carotene or the carotenes of raw or cooked spinach and carrots. At low feeding levels there was a great variation in utilization within groups and females in these groups absorbed carotene better than males. The absorption spectra of negative control rat's feces decreased in density with increasing wave length from 3000 to 5000 A^{o}. When carotenes were fed, there was superimposed upon this, absorption maxima, characteristic of carotenoids. The absorption not due to carotenoids necessitated the use of a suitable blank obtained, in this case, from the negative control group.

Rats stored no vitamin A in the liver at any levels fed. Absorption spectra of extracts of rat livers from wave lengths of 2200 to 5000 A^{o} decreased

in density with increasing wave length except for a maximum between 2500 and 2600 A°. This absorption would necessitate the use of suitable blanks for the spectrographic determination of vitamin A in rat livers.

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A STUDY OF THE FACTORS INFLUENCING
THE RELEASE OF LEAD FROM THE
TISSUES OF THE MOUSE

Grant Saunders Winn, Thesis (Ph.D.)
Purdue University, 1940

It has been found possible to obtain the same results, within reasonable limits, from the use of the very rapid and convenient polarographic method of lead analysis, when the amount of lead per sample approximates one milligram, and the widely accepted, but time-consuming dithizone method. These data have justified the use of the former method for this work.

Dietary calcium, vitamin D and phosphorus, as well as changes in the reaction of the diet, are ineffectual in the release of lead previously deposited in the tissues of adult mice. This is true after one week or after three weeks on diets containing appropriate amounts of these agents.

An experiment including but two groups of mice indicated that vitamin C, under the conditions maintained, caused a remarkable improvement, physically, of previously "leaded" mice, but did not accelerate lead excretion. The suggestion of Holmes et al (23) that a slightly ionized complex formed by the interaction of lead and vitamin C is given as a possible explanation of the results observed.

The failure of cod-liver oil to influence lead excretion, contrary to what would be expected from the work of Aub et al (12), is explained by assuming that vitamin D exerts its effect in the intestinal tract by regulation of the absorption of lead, and hence cannot influence previously deposited lead. The fact that adult mice instead of growing animals were used may have been a determining factor in this case.

Negative results with calcium, as in the case of vitamin D, are explainable on the basis of the probability that calcium influences lead metabolism only when the two are present simultaneously in the gut. The recent work of Lederer and Bing (26) support this view.

In the light of the results presented here and of those reported by Lederer and Bing (26), the necessary conclusion seems to be that dietary phosphorus is not concerned with the rate of absorption or of excretion of lead.

From a purely logical standpoint it is somewhat more difficult to understand why the reaction of the diet has no influence upon the excretion of previously deposited lead. Two possibilities present themselves in explanation: (1) The lead may be mobilized from the bones along with the calcium, but is later redeposited in the skeletal structure; (2) Calcium may be mobilized from the shaft of the bone, leaving the lead deposited in the trabecula.

It may be concluded that the rate of excretion of lead which has previously been deposited in the tissues of the mouse is, under the conditions employed, not influenced by feeding different relative amounts of the dietary factors calcium, phosphorus, cod-liver oil, and ascorbic acid, nor by changes in the reaction of the diet.

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BIOLOGY

FACTORS AFFECTING THE RESPIRATION OF ISOLATED TISSUE

Carl McGee Meadows, Thesis (Ph.D.)
Purdue University, 1941

The Dicken and Simer (1930) modification of the Warburg technic was used to measure the respiratory exchange of the slices of liver tissue. Tissue was prepared by killing the animal without anesthesia, removing the liver as quickly as possible and cutting the organ into thin even slices.

Both the oxygen uptake and carbon dioxide production of the liver slices were measured in all but a few experiments, the nature of which allowed only the measurement of oxygen consumption. From the oxygen used and the carbon dioxide liberated the respiratory quotients (R.Q.) and oxygen quotients (TQo_2) were calculated.

By substituting isotonic KCl solutions for physiological saline it was possible to inhibit the combustion of carbohydrates by liver slices rich in glycogen. The restoration of carbohydrate metabolism in these liver slices in the presence of high concentrations of potassium was brought about by the addition of less than normal amounts of NaCl. Excessive amounts of KCl, however, did not have a general toxic affect on overall metabolism.

Isotonic LiCl had the same inhibitory action as the KCl solutions, but the general toxic effect was not noted. Larger amounts of NaCl were required for restoration in the presence of LiCl than in the presence of KCl. A rapid diffusion rate for or an alteration of cell permeability by LiCl is suggested as an explanation for this last mentioned observation.

The ability of NaCl to raise the R.Q. of glycogen rich liver slices in the presence of excess KCl or LiCl seems to justify the assignment of the observed effects to a sodium deficit.

That the absence of sodium does not destroy the ability of liver tissue to oxidize all substrates is demonstrated by increased oxygen uptake in the presence of succinate, fumarate, butyrate and pyruvate. The apparently complete oxidation of pyruvate in isotonic KCl indicates that some step prior to the formation of this material is blocked.

The inhibition mentioned above is of the same order of magnitude as that caused by NaF a known inhibitor of carbohydrate oxidation.

Cyanide was found to be generally toxic to tissue respiration without altering the R.Q. when as much as 80-85% of the respiration had been blocked.

No significance could be attached to $MgSo_4$, iodoacetic acid or vitamin B_1 in these experiments.

It is believed that good evidence has been obtained for the existence of significant relationships between sodium and potassium disturbances and other abnormalities of adrenal insufficiency. The TQo_2 and R.Q. variations definitely point to interferences with carbohydrate oxidation under the conditions of sodium lack, and such a contention agrees well with the losses of sodium known to occur in adrenalectomized animals.

It is very interesting to associate the mineral exchanges of muscle occurring in fatigue with the findings reported here. Fenn (1940), in a review, states that muscular activity leads to a loss of K in exchange for Na. Other results to which this same idea can be applied are those obtained by Brewer (1940), who found that metabolic stimulants such as low environmental temperature and dinitrophenol cause a rise in blood potassium. The idea that potassium migrates from the cell in favor of the entrance of sodium which is needed to support the processes engaged in increased energy production is quite attractive.

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BOTANY

EFFECT OF NUTRITION ON THE REACTION OF CEREALS TO LEAF RUST

Kenneth Davis Doak, Thesis (Ph.D.)
Purdue University, 1931

A study was made of the reaction of eight wheat varieties to Puccinia rubigo-vera tritici (D. C.) wint., race 5, and of 4 inbred lines of corn to Puccinia sorghi Schw. race 1 under varied conditions of mineral nutrition of the hosts and carbon dioxide content of the atmosphere.

Nitrogen in excess increased the susceptibility of two highly susceptible wheat varieties, Michigan Amber 29-1-1-1 and Little Club C.I.4066, a moderately susceptible variety, Hope C.I.8178, two moderately resistant varieties, Hussar C.I.4843 and Kanred P762, and three highly resistant varieties, Warden C.I.4994, Webster C.I.3780, and Double Einkorn-1. Increase in size of primary uredea, more abundant secondary uredea, and decreased chlorosis characterized the change in the highly susceptible varieties. The moderately susceptible variety, Hope, was affected in the same manner with the exception that secondary uredea formation was slight. The moderately resistant varieties and the highly resistant variety, Warden, showed an increase in the percentage of lesions with uredea and a decrease in chlorosis and necrosis. Although the two highly resistant varieties, Webster and Double Einkorn showed a slight increase in the size of necrotic areas, uredea formation did not occur.

Nitrogen deficiency produced effects directly opposite to those of excess nitrogen, namely, increased chlorosis, decreased size of primary uredea, and reduction in the numbers of secondary uredea in the susceptible and moderately susceptible varieties,

increased chlorosis and necrosis and decreased uredeum formation in the moderately resistant varieties and the resistant variety, Warden, and decreased necrosis in the highly resistant varieties.

Phosphorus in excess induced the following changes in rust reaction: increased chlorosis, slight decrease in size of primary uredea, and reduction in numbers of secondary uredea in susceptible and moderately susceptible varieties; increased necrosis and chlorosis and reduction in the numbers of uredea formation in the moderately resistant varieties and the resistant variety, Warden and increased necrosis in the highly resistant varieties.

Phosphorus deficiency induced the following changes in rust reaction: decreased size of primary and secondary uredea and decreased chlorosis in susceptible and moderately susceptible varieties; decreased chlorosis and necrosis in moderately resistant varieties; and decreased necrosis in resistant and highly resistant varieties.

Potassium in excess induced the following changes in rust reaction: increased chlorosis, decreased size of primary uredinia, and reduction in amount and size of secondary uredea in susceptible and moderately susceptible varieties; increased necrosis and chlorosis, and decreased numbers of uredea in moderately resistant varieties and the resistant variety, Warden; and increased necrosis in highly resistant varieties.

Potassium deficiency induced the following changes in rust reaction: decreased chlorosis, increased size of primary uredea and numbers of secondary uredea in susceptible varieties; decreased chlorosis and increased size of primary uredea in the moderately susceptible variety; decreased necrosis and chlorosis and increased numbers of uredea in moderately resistant varieties and the resistant variety, Warden; and decreased necrosis in the highly resistant varieties.

Corn varieties were affected in the same manner

as was wheat by excess or deficient nitrogen, phosphorus, and potassium.

Sodium silicate was effective in increasing the resistance of susceptible varieties by inducing extensive chlorosis around the uredinia and delaying or preventing the formation of secondary uredinia without causing any apparent reduction in growth or change in the condition of plants.

Lithium chloride at low concentrations induced chlorosis around the uredinia, but this was due to toxic effects on the plants because leaf killing occurred at the higher concentration.

Many of the treatments producing decreased development of rust were effective because of the toxic effects on the plants because of a reduction in growth closely paralleling the decreased rust development.

Copper, zinc, and manganese sulphates supplied in increasing concentrations induced symptoms of increased resistance in a susceptible and moderately resistant variety, but the change corresponded closely to reduced growth of the plants.

Studies of the relationship of atmospheric concentration of carbon dioxide to rust development showed that size of uredio was reduced by concentrations lower than that of air and was increased by concentrations greater than that of air.

Rust infection resulted in increased hydrogenion concentration of wheat leaf cell-sap. Although the different nutrient treatments affected the hydrogen-ion concentration of the leaf cell-sap of uninfected plants, modifications in the development of rust were not positively correlated with the degree of change in hydrogen-ion concentration caused by infection or by the nutrient treatment.

Fertilizer applications on field plots at Vincennes, Rensselaer and Lafayette, Indiana, showed the following effects on amount of rust and yield of grain:

a. Nitrogen applied in moderate amount to a soil

deficient in this element produced a large increase in both rust and yield. When twice this amount was applied, further increase in the amount of rust occurred while the yield remained almost the same. Compared with the unfertilized plots, potassium applied with nitrogen resulted in a relatively high yield and marked decrease in the amount of rust. Complete fertilizer gave yield increases considerably less than nitrogen alone while the amount of rust was not greater than on the unfertilized plots.

Potassium supplied to soil deficient in this element gave an increased yield without increasing the amount of rust. Nitrogen plus potassium or a complete fertilizer gave greater increases in yield as well as in the amount of rust.

Phosphorus or potassium applied to a soil deficient in all three elements gave marked increases in yield and no perceptible increase in rust. When nitrogen was applied, however, either with phosphorus alone or in a complete fertilizer, rust was greatly increased and the highest yields occurred.

The most resistant types of reaction for both the susceptible and resistant varieties occurred on plots showing the smallest amount of rust.

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CHEMISTRY

THE PRODUCTION OF DRYING OILS BY THE CHLORINATION AND DEHYDROCHLORINATION OF HIGH MOLECULAR WEIGHT HYDROCARBONS

Leland Kenneth Beach, Thesis (Ph.D.)
Purdue University, 1940

Rates of Thermal Dehydrochlorination of Chlorinated Hydrocarbons

To produce fast drying oils from a chlorinated wax, containing about 36% chlorine, a substantially complete dehydrochlorination is desirable. Unsuccessful efforts completely to thermally dehydrochlorinate a chlorinated paraffin using a method found in the literature led to a brief study of the rates of dehydrochlorination of various chlorinated waxes at several temperatures.

The starting material for this study was a semi-refined wax from Pure Oil Company. Its melting point, 124-126°F. (A.S.T.M.), corresponds approximately to a $C_{24}H_{50}$ molecule average. This wax chlorinated in Pyrex at 70 = 3°C. in the presence of three 75 watt Mazda lamps. The chlorine contents were determined by gain in weight or by the standard Carius method.

The dehydrochlorination was carried out in a 4 x 30 cm. Pyrex tube immersed in a $NaNO_2$-$NaNO_3$ bath. The chlorine liberated was collected in one of two scrubbers in parallel after having passed a trap kept at room temperature to take out mist and oil vapors. The scrubbers were used alternately, the HCl solutions being removed and titrated at recorded intervals.

Wax containing 35.8% chlorine was almost completely dehydrochlorinated in one hour at 325°C. or above. Below this temperature the time for complete

dehydrochlorination is much greater, being probably over 20 hours at 250°C.

Extraction of a Dehydrochlorinated Wax

The acetone extraction of a thermally dehydrochlorinated chlorinated wax was carried out at room temperature in a tube fitted so that fresh acetone entered the bottom of the oil and rose to overflow to the boiler in which the acetone was removed from the extract. The chlorinated wax contained 35.8% chlorine and was dehydrochlorinated at 310-350°C. for 1.5 hours. The molecular weight iodine number, (Hanus), specific dispersion and the drying times of the extracts were determined. The drying times were determined under controlled conditions on a Sanderson Drying Machine.

It is seen that components quite soluble in acetone are of low molecular weight. The specific dispersion values give little evidence of a change in type from the first to the last extracts. The drying time for the various extracts is seen to become positive function of the molecular weight and surprisingly it seems to be little affected by the iodine number. Two possible explanations of this are: 1, the faster drying oils contain conjugated systems which do not produce correct iodine numbers; 2, more probably the drying ability is a positive function of the number of double bonds per molecule.

Another factor is the extent of drying necessary to make a film become hard. In this respect also the high-molecular weight extracts are favored because of the higher melting points of their individual components.

The last extracts were quite light in color and formed very desirable films when compounded with Co Nuodex drier and dried. The fast drying residue was very black and viscous.

Color Formation and Avoidance

One of the most formidable obstacles in the production of satisfactory drying oils by the chlorination-dehydrochlorination route is that of color removal or avoidance. The dehydrochlorinated oils may be distilled to give good yields of light colored distillates, but these distillates are invariably of poor drying quality. The last acetone extracts of the dehydrochlorinated oils are of good color and good drying quality, but constitute only a few per cent of the total oil.

Work by Bailey showed that dehydrochlorination with sodium ethoxide and ethanol produced less color and occurred at a lower temperature than by strictly thermal means. A chlorinated C_{14} Michigan kerosene fraction was distilled at reduced pressure to give an oil containing roughly four chlorines per mole. This tetrachloride was partially dehydrochlorinated, distilled and 15 g. of the distillate treated at 150°C. for 6 hours with 10 g. sodium ethoxide and 10 cc. absolute ethanol. The oil obtained by this treatment was lighter in color than ordinary linseed or tung oil.

It appears that in the distillation of the chlorinated C_{14} and in the subsequent dehydrochlorination-distillation the potential color forming substances were developed and polymerized so that they were not distilled with the bulk of the partially dehydrochlorinated material. The subsequent relatively mild chemical dehydrochlorination did not produce any more color.

The formation of color during the dehydrochlorination of a chlorinated wax is rather rapid and seems to reach a constant value.

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THE MEASUREMENT OF THE HEAT CAPACITIES OF 1-NITROPROPANE AND NITROETHANE

G. Victor Beard, Thesis (Ph.D.)
Purdue University, 1940

Heat capacity is defined as $q/\Delta T$ or $C_P = (\partial H/\partial T)_P$. Its measurement usually involves measuring q and ΔT directly; however, it can be measured by determining the variable in this equation $C_P = \frac{q}{\Delta V} \cdot \frac{\Delta V}{\Delta T}$. This method offers a comparatively new approach to the problem (1) and is the method used here. q and ΔV are measured simultaneously in one operation. ΔV and ΔT are measured simultaneously in a second operation.

The apparatus consists of two parts: one part measures directly the variables q and ΔV and the second part measures directly ΔV and ΔT. The general plan of the first apparatus is apparent from Plate 1. q is measured by taking volts times coulombs. Volts are measured by using a potentiometer and coulombs are measured by using a gas coulometer containing nickel electrodes immersed in a 15 per cent NaOH solution. The source of current is a 110 volt D.C. generator with three six volt, lead storage batteries "floated" across the circuit in the manner shown in Plate 1.

Plate 2 shows a 500 ml. round bottom flask through the bottom of which are sealed two tungsten electrodes. These electrodes are spot welded to two short pieces of nickel wire which in turn are spot welded to a 0.3 ohm, No. 32, platinum resistance wire. The flask has fused to it near the bottom a diagonal bored, capillary stopcock. It has the same type of stopcock near the top of the flask. On top

of this stopcock is a small glass reservoir. The flask also has a section of carefully calibrated small diameter, capillary tubing fused to it at the top of the flask. This capillary tubing has attached to it the measuring scale used to calibrate the tubing. This whole apparatus fits into a water-tight glass jar which has had the top remodeled so that the capillary tubing and measuring device emerge through the top. The glass jar and contents are kept in a water bath whose temperature is controlled to $0.003^{o}C$.

A measured quantity of heat is generated in the platinum heating coil and the meniscus rise in the capillary tubing is carefully noted. This gives us q and $\triangle V$.

Certain precautions are necessary in this operation. The whole system is allowed to come to equilibrium with the top stopcock open. This is closed and if the meniscus in the capillary tube is stationary the system is in equilibrium. The meniscus height is recorded, the current is turned on, the voltage is read, the current is turned off, and the final meniscus height is recorded. It is essential that the meniscus continues to rise, or at least remain stationary for several seconds after the current is turned off. This insures that heat is not being lost by convection. The current is usually run from 5 to 10 seconds. The amount of gas collected is from 5 to 10 ml. and the meniscus rise from 5 to 10 cm.

The second piece of apparatus measures $\triangle V$ and $\triangle T$ (Plate 4). It is essentially a dilatometer and consists of a 500 ml. flask on which is fused a stopcock for filling and a calibrated capillary tube. The apparatus is put in the glass jar and the whole put in the water bath and allowed to come to equilibrium at a temperature about 0.5^{o} C. above the desired temperature. The meniscus height is read; it should be near the top of the capillary tube. The temperature of the bath is lowered to about 0.5^{o} C. below

the desired temperature and the meniscus height again read. After correcting for hydrostatic effects and expansion effects we get ΔV and ΔT.

If the densities of the liquids being investigated are known with sufficient accuracy this apparatus is not used. dV/dT is then determined as follows:

$$V = \frac{M}{D} \qquad \frac{dV}{dT} = \frac{M}{D^2}\frac{dD}{dT}. \qquad (1)$$

The 1-nitropropane and nitroethane were obtained from Commercial Solvents. They were dried successively with $CaCl_2$ and Drierite. The 1-nitropropane was fractionated in a 30 plate column using a high reflux ratio and it was collected over a 0.2°C. boiling range. The nitroethane was fractionated twice in this same column and the second fraction was collected over a 0.3°C. boiling range. The 1-nitropropane was probably very pure. The nitroethane probably had some 2-nitropropane remaining in it. However, since the partial molal heat capacities of these two substances are close, it is believed the error produced is well under the precision of the apparatus.

	Heat Capacities	
Temperature	Nitroethane	1-Nitropropane
25	0.441 ± 1%	0.470 ± 1%
35	0.437 ± 1%	0.440 ± 1%
45	0.437 ± 1%	0.462 ± 1%
50	0.438 ± 1%	0.489 ± 1%

The minimum in the heat capacity curve for 1-nitropropane is to be attributed to the tautomeric equilibrium

$$CH_3CH_2CH_2NO_2 \rightleftharpoons CH_3CH_2\overset{H}{C} = \overset{OH}{N}\text{-}O \qquad (2)$$

No satisfactory explanation can be given at present for the observed straight line representing the heat capacity of nitroethane.

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THE AMINATION OF HETEROCYCLIC COMPOUNDS

Lloyd Berg, Thesis (Ph.D.)
Purdue University, 1942

The purpose of this thesis was to prepare amino-pyrazine by a method other than the Hoffman degradation of the amide of pyrazine monocarboxylic acid.

Attempts to prepare aminopyrazine by means of the Oesterlin reaction, treating the pyrazine monocarboxylic acid with sodium azide in acid solution followed by hydrolysis, failed to yield any identifyable product.

When the methyl ester of pyrazine monocarboxylic acid is treated with hydrazine hydrate, the hydrazide is produced in 90-95% yield. This is a new compound presented to the literature. It forms in fine white needles and melts at 168.5°C., corrected. An elemental analysis yielded-calculated: C = 43.45%, H = 4.35%, N = 40.6%, O = 11.6%; found: C = 43.22%, H = 4.55%, N & O = 52.23%.

When the pyrazine monocarboxylic acid was treated with an excess of thionyl chloride, the acid chloride formed in 95% yield. This new compound is a purple, powdery solid and melts at 220°C., corrected.

When pyrazine is aminated with sodium amide in a medium of liquid ammonia, dipyrazylamine is formed in small quantities. This, too, is a new compound presented to the literature. It is a light yellow powder and melts at 175°C., corrected. An elemental analysis yielded--calculated: C = 55.5%, H = 4.05%, N = 40.45%; found: C = 56.5%, H = 3.9%, N = 39.6%.

At elevated temperatures, 35 - 138°C., the amination of pyrazine with sodium amide yields little aminopyrazine.

Better results in the amination of pyrazine with sodium amide are obtained by shaking these two reagents in a medium of either dioxan or pyridine for 24-48 hours at 25°C. Results showed that up to 16% conversion and 80-95% yield of amino-pyrazine could be obtained.

The best method for the production of amino-pyrazine was to treat pyrazine with sodium amide without any addditional solvent at 50-55°C., just above the melting point of pyrazine. Conversions of 7-11% and total yields of about 40-60% based on recovered pyrazine were obtained.

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PREPARATION AND PROPERTIES OF WETTING AGENTS FROM KEROSENE

Duncan James Crowley, Thesis (Ph.D.)
Purdue University, 1940

The properties of various kerosene fractions were studied and evidence was obtained which indicated that the 5 degree cut (95-100°C. at 15 mm.) did not contain more than 50 per cent n-paraffins. Samples of fractions corresponding to hexadecane and heptadecane were found to contain even less than 50 per cent (30-40 per cent) normal paraffins.

Attempts to hydrolyze the monochlorides by means of a modified formate procedure proved to be only partially successful. Vapor phase hydrolysis failed to produce alcohols.

The use of aqueous-alkaline methods of hydrolysis was investigated extensively. Experiments were carried out using sodium hydroxide, sodium carbonate, sodium bicarbonate, calcium hydroxide and calcium carbonate as the alkaline reagent. Most of the hydrolyses were run at 150-170°C. in a stirring autoclave in which the ratio of water to chlorohydrocarbon was approximately 200 moles to one. The average alcohol yield was in the neighborhood of 25-30 per cent, the rest of the product being olefinic in nature. The alcohol yield appeared to be largely a function of temperature.

In a like manner hydrolyses were carried out in which additional reagents such as emulsifying agents and acetone were added to the aqueous-alkaline solution. These were found to speed up the rate of reaction considerably. However, it appears that the rate of olefin formation is faster than the rate of alcohol formation.

Apparatus was constructed by which aqueous sodium hydroxide was pumped by means of a proportioning

pump into the autoclave during the reaction. The pH of the reaction medium was followed by means of measurements on samples of the mixture with a glass electrode. Pumping was adjusted in such a manner so as to maintain a constant pH in the autoclave. However, such control did not affect the alcohol yield to any appreciable extent.

An experiment carried out to determine the type of the reaction indicated that the aqueous-alkaline hydrolytic process may be considered as a first order reaction.

Alcohols, (containing 12 carbon atoms), obtained by the hydrolytic procedure were sulfated and the alkyl sulfates produced were tested for their wetting power. They proved to be satisfactory wetting agents, although somewhat inferior to the 15 carbon atom alkyl sulfates.

Methyl heptyl ethers were prepared and attempts were made to sulfate them. It was not possible to isolate any alkyl sulfates from the reaction mass, so it was concluded that ethers do not sulfate under the conditions which were used to sulfate the corresponding alcohols.

Attempts made to treat the monochlorides with sulfur trioxide and subsequent hydrolysis to produce the alkyl sulfates were unsuccessful.

The olefins obtained during the hydrolysis were sulfonated in the presence of ether at 0-10°C. and the resulting alkyl hydroxy sulfonates were found to be fairly good wetting agents as measured by the Draves, Clarkson procedure. Although the product was pale yellow in appearance it was only slightly inferior to the alkyl sulfates.

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THE VISCOSITY OF QUASI-IDEAL MIXTURES AND THE IDEAL LAW OF MIXTURES FOR VISCOSITY

Herbert Sidell Lecky, Thesis (Ph.D.)
Purdue University, 1941

New data on the fluidity and volume changes on mixing for nineteen quasi-ideal binary systems are presented. It is not possible to make a choice among several "ideal" mixture laws for fluidity on the basis of these data and those in the literature.

Using the simplest "ideal" law $\phi = N_1\phi^\circ + N_2\phi_2^\circ$ as a basis, large positive and negative deviations are observed. Volume changes on mixing are an important factor in causing deviations from the ideal; if the difference in the heats of vaporization of the components is small, the fluidity deviations parallel the volume changes on mixing. If there are large differences in the heats of vaporization of the components there is a large negative deviation in the fluidity superimposed on that due to volume changes. This latter effect is ascribed to a clustering of the more polarizable molecules in the liquid leading to a pseudo-structural viscosity similar to that observed in colloidal solutions.

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THE EFFECT OF VARIOUS FACTORS UPON THE STRUCTURE AND APPEARANCE OF ELECTRODEPOSITED ZINC

George Perkins, Thesis (Ph.D.)
Purdue University, 1940

This investigation consisted chiefly of the observation of the results obtained by electroplating zinc from a zinc sulfate-sulfuric acid bath on to cathodes of low-carbon steel wire under certain controlled conditions. Insoluble lead and lead-alloy anodes were used and only relatively high (200-1000 amp. sq. ft.) current densities were employed.

A limited study has been made of the effect of concentration of the $ZnSO_4$ and rate of motion of the cathode while the effects of current density, anode composition and addition agents are studied at more length.

It has been shown that:

1. If electrolyte is occluded within the zinc deposit, it is present in amounts less than 2×10^{-10} grams of SO_4^{--} per square inch.

2. In order to secure continuous zinc deposits from a solution containing 295 grams of $ZnSO_4$ per liter and 0.5N in H_2SO_4, a current density of at least 50 amperes per square foot is required.

3. Low current densities will produce better deposits from solutions weak in $ZnSO_4$ than high current densities; whereas in stronger solutions, the better deposits are produced at higher current densities.

4. Rougher, darker colored deposits having more craters and a poorer luster and deposited at lower current efficiencies are produced when anodes containing Sb and Te are used than for anodes of pure Pb, Pb-Ag, etc.

5. The detrimental effects produced by the use of a Pb-Sb anode are minimized by rapid motion of the cathode.

6. Rough deposits are associated with a larger particle size and higher Pb content.

7. An anode on the Ag-rich side of the Pb-Ag eutectic will give approximately ten times the amount of Ag in the zinc as one on the Pb-rich side, with no appreciable difference in the amount of Pb.

8. The deposits from the Pb-Sb and Pb-Te anodes probably possess an orientation different than that of the samples from the other Pb-alloy anodes, but both types are orientated.

9. A novel method for comparing the roughness of various samples has been used.

10. No addition agent used improved the color of the deposits but an extremely large percentage of them produced deposits having fewer craters than the standards.

11. The nitrogen compounds increased in effectiveness in the order aliphatic--aromatic--heterocyclic.

12. All nitrogen compounds are not effective as addition agents but those containing amino-nitrogen atoms are, and those containing more than one amino-nitrogen atom are particularly good.

13. The effectiveness of these agents is probably a result of adsorption to the metal surface.

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CHLORINATION OF CERTAIN ALIPHATIC ACIDS AND THEIR DERIVATIVES

John Frederick Quinn, Thesis (Ph.D.)
Purdue University, 1942

Propionic, n-butyric, isobutyric acids and certain of their derivatives when acted upon by elementary chlorine in the presence or absence of light give all possible monochloro isomers.

The yield of beta or beta and gamma monochloro isomers is materially greater than that of the corresponding alpha isomer when the acid, the acid chloride, or the esters are chlorinated. The isomeric ratio of monochloro derivatives obtained is practically independent of the type of compound chlorinated. Acid chlorides generally give a slightly lower alpha to beta ratio.

Temperature affects the ratio of isomeric monochlorides produced. At high temperatures there is an increase in the alpha to beta monochloro ratio and, conversely, at low temperatures a decrease in this ratio is observed.

Increased pressure has the effect of slightly increasing the tendency towards primary substitution.

Catalysts including charcoal, acetyl chloride, sulfur dioxide, and sulfur monochloride do not alter the isomeric ratio. Acetyl chloride and sulfur dioxide do, however, noticeably increase the over-all rate of reaction. Sulfur at high temperatures and iodine favor increased alpha substitution. Sulfur at only slightly elevated temperatures has no apparent effect.

Esters of the corresponding acids chlorinate readily at rates in excess of those for the acids or acid chlorides. Losses due to polychlorination are reduced also in the cases of the esters.

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HYDROGENOLYSIS OF PENTOSE SUGARS

John Robert Roach, Thesis (Ph.D.)
Purdue University, 1942

Although D-xylose is the only pentose sugar potentially available in large quantities, and it is not at present a commercial product, the pentosans could be obtained from that fraction of plant material known as waste products. Considered in this class are cotton seed hulls, corn cobs, corn stalks, peanut shells and hulls, oat hulls and sugar beet wastes--materials containing up to 40% pentosans.

For this investigation a copper-thorium-uranium catalyst (Hydrogenolysis Catalyst number 86-B) was furnished by Commercial Solvents Corporation. After studies on hydrogenolysis of D-xylose were carried out, the conditions resulting in the best yield of ethylene glycol and propylene glycol were used for runs on L-arabinose.

In the majority of runs, depending on the study being made, 25 g. of D-xylose and 2 g. of catalyst were ground up with a mortar and pestle and 50 ml. of methanol was added to the mixture. In runs made in a basic medium the alkaline reagent was added at this point and the mixture was immediately hydrogenated. At the end of the desired period of reaction the hydrogenolysis bomb and contents were immediately cooled in cold water and the excess hydrogen in the bomb was released through a concentrated sulfuric acid trap and then through weighed ascarite-dehydrite tubes to determine the amount of carbon dioxide formed.

After removal of the solvent, the hydrogenolysis mixture was distilled under vacuum, without any attempt being made to obtain a separation. The

hydrogenolysis products were then separated into a fraction boiling between 180 and 200°C., which was designated as the glycol fraction, and a fraction boiling between 200 and 280°C. The 180 to 200° fraction consisted of ethylene glycol and propylene glycol, and the ratio of these two products was determined by a density determination.

Ethylene glycol, propylene glycol, and carbon dioxide were identified as products of hydrogenolysis. Using refractionated methanol as the solvent for the reaction a good iodoform test was given by the methanol fraction when it was recovered. Although this is not definite proof that ethanol is a product of hydrogenolysis it is the most likely possibility. When ethanol was used as the solvent for the reaction, methanol was not detected as being a product of hydrogenolysis upon using the sensitive test of Wright (28) for the detection of the presence of methanol in an ethanol solution.

The best yield of glycol fraction was obtained when a run was made using 25 g. of D-xylose, 2 g. of catalyst, 50 ml. of methanol, 1 g. of sodium hydroxide, pressure of 2800 lbs. per sq. in. when at 218°C. at start of reaction, temperature of 218°, and time of run nine hours. Under these conditions the yield of glycol fraction was 62.6%. Upon using the same conditions, except that the alkaline reagent was omitted, the maximum yield of glycol fraction was 21.2%, but a larger amount of products boiling between 200 and 280°C. was obtained, the maximum yield of this fraction being 17.4%.

A number of alkaline reagents were used with approximately equally good results. The reagents which proved to be satisfactory were sodium hydroxide, potassium hydroxide, sodium carbonate, barium hydroxide, and sodium methoxide. As one would expect when employing a catalyst containing copper, the use of ammonium hydroxide did not give good hydrogenolysis results. Pyridine and calcium hydroxide evidently poisoned the catalyst since no hydrogenolysis was obtained when they were used.

Methanol was found to be the best solvent for hydrogenolysis of xylose, both from the standpoint of yield of glycol fraction and ease of removal of solvent from the hydrogenolysis mixture. Ethanol and dioxane were used as solvents on runs resulting in poor yields of the glycol fraction. The use of water and pyridine both resulted in no hydrogenolysis reaction.

Most of the reaction was shown to take place during the first three hours of a run. Slightly higher yields were obtained when the runs were continued for nine hours.

When the glycol fractions from a number of runs were combined and redistilled, the distillate corresponded to a mixture of 28% ethylene glycol and 72% propylene glycol. This constitutes a mixture of the two in the ratio of one mole of ethylene glycol to two moles of propylene glycol. From this it is obvious that accompanying the formation of propylene glycol only half of the two carbon fragment is converted into ethylene glycol. This could account for the formation of some ethanol.

In view of the investigations made on D-xylose, runs were made on L-arabinose and as one would expect from the Lobry de Bruyn-Van Eckenstein equilibrium, no appreciable difference in results was obtained. The best yield of glycol fraction from L-arabinose was 62.2% as compared to the 62.2% as compared to the 62.6% yield from X-xylose.

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ALKYL SULFATES FROM PARAFFINS OF TWELVE TO EIGHTEEN CARBON ATOMS

Barney Ralph Strickland, Thesis (Ph.D.)
Purdue University, 1939

Kerosene and gas oil from a Michigan crude containing a high percentage of n-paraffins were fractionated under vacuum.

A fraction from kerosene boiling at 95-100°C. at 15 mm. pressure and corresponding to n-dodecane, another kerosene fraction boiling at 140-145°C. at 15 mm. pressure and corresponding to n-pentadecane, and a fraction from gas oil boiling at 163-170°C. at 10 mm. and corresponding to n-octadecane were chlorinated to yield principally monochlorides. Chlorinations were carried out (1) in an open flask in the dark, (2) in an open flask in the presence of light, and (3) under 1000 pounds per square inch of pressure in a Monel metal and nickel apparatus. The reaction proceeded readily under any of these conditions at from 100-160°C.

The monochlorides were hydrolyzed by several procedures. That used by Ayres was tried but with poor results. Nef's method, using sodium formate and anhydrous methanol, was employed. It was found that methoxy derivatives were obtained when Nef's method was used and that more alcohol and less ether would be obtained if water were added to the methanol used. Hydrolyses were also carried out using ethanol and 2-propanol, both anhydrous and with up to 33% water, and carbitol as solvents to replace methanol. Carbitol was effective but ethanol and 2-propanol were ineffective. Hydrolyses were carried out in a stationary stainless steel autoclave. About 40% yields of alcohols were the best obtained, the remainder of the alkyl chlorides yielding methyl ethers

and olefins. Much more strenuous conditions were required to cause C_{15} and C_{18} monochlorides to react than were required for the C_{12} derivatives.

Mixed alcohols and ethers from C_{12}, C_{15}, and C_{18} monochlorides were sulfated with chlorosulfonic acid in 2,2'-dichlorodiethyl ether solution. Sodium alkyl sulfates were produced and recovered in the form of waxy solids. The alcohols gave quantitative yields of sodium alkyl sulfates. The ethers in the mixture were apparently also partly converted to alkyl sulfuric esters under the same conditions but at a much slower rate. Quantities of sodium alkyl sulfates in excess of the theoretical quantity from the alcohols used were obtained.

Methyl ethers from the C_{12} monochlorides were freed of alcohols and olefins and treated with chlorosulfonic acid for a prolonged period. As evidence that the ethers were sulfated, the chlorosulfonic acid was consumed, the chlorine of the chlorosulfonic acid escaped and a solid product, soluble in anhydrous methanol and possessing definite foaming properties, was produced upon neutralizing and evaporating. It was concluded that the chlorosulfonic acid had reacted with the ethers to produce alkyl sulfuric esters and that chlorine had been evolved as methyl chloride.

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ECONOMICS

A COURSE OF STUDY IN INTERPRETATIVE ACCOUNTING

Edward I. Crawford, Thesis (Ed.D.)
New York University, 1946

The Problem. This study was undertaken for the purpose of: (a) Ascertaining whether or not present practices in teaching bookkeeping and accounting correspond with current objectives; (b) determining the thinking of business educators relative to advisability of incorporating into the high school curriculum a course of study in interpretative accounting; that is, a course involved with the nonvocational features of bookkeeping, which uses the interpretative approach; and (c) collecting materials and preparing a syllabus for such a course if the investigation demonstrates a felt need for it.

Methods of Procedure. The normative-survey method was used. A search of business education literature was made to ascertain the present status and current objectives of teaching bookkeeping and accounting. To determine opinions of business educators on certain aspects of such a course, inquiry blanks were sent to high school bookkeeping and college business education teachers selected by random sampling from all parts of United States.

Status of Bookkeeping and Accounting. In spite of the fact that not over 10 percent of those trained in vocational bookkeeping secure positions as bookkeepers, materials and methods of instruction in general use today do not differ in principle from the formalistic techniques which prevailed early in the century.

The objectives, on the other hand, have made marked changes. The disciplinary, character development, cultural, and educational objectives have

disappeared entirely, and the vocational objective occupies a position of secondary importance. In their places have appeared objectives stressing social, personal use, general business, interpretative, and other nonvocational values. Composite statements of these nonvocational objectives follow:

a. To develop in an individual the ability to keep his own financial records of receipts and expenditures and a general understanding of how to look after his own interests in carrying on business dealings with others
b. To provide students with a general knowledge of how business operates
c. To develop an understanding of the functions and values of business records and reports
d. To show relationships between the records that are provided by the bookkeeper and the various parts of the business organization
e. To develop a business vocabulary
f. To provide a background of knowledge relative to the organization and operation of a business primarily as basic information for those who wish to enter business for themselves
g. To develop in the students an appreciation of and a desire to promote good business ethics
h. To develop an ability to analyze and interpret business forms, reports, and practices
i. To provide a background for a better understanding of the materials which will be encountered in the study of bookkeeping and accounting if these subjects should be pursued later

Conclusions from Responses to the Questionnaire Survey. Based on replies received from respondents, the following conclusions were drawn:

a. In addition to the currently offered courses in vocational bookkeeping, there is a felt need in the high school curriculum for a course in nonvocational bookkeeping which teaches students how to analyze and interpret business forms, reports, and practices.

b. This course should be developed for the 12th grade level.

c. All students in the high school of the proper grade level should be encouraged to take this course.

d. The title of the course should be such as to best portray what the course is developed to accomplish.

Course of Study. From suggestions made by respondents in the inquiry blanks and from other available materials, a syllabus for a two-semester course in interpretative accounting was prepared. The general objectives decided upon for the course were the current nonvocational objectives presented above. Before final selection, each item was evaluated on a basis of accepted selective criteria.

The selected materials were divided into fifteen unit groups. A title and a specific objective were developed for each unit. The following titles were used:

Organization and Operation of a Business
Budgeting and Personal Record Keeping
Interest
Dealings with Retail Stores
Consumer Credit Charges
Producers and Wholesalers
Personal Insurance
General Insurance
Financing Business Enterprise
Income
The Balance Sheet
Profit and Loss Statement
Dealings with a Bank
The Market
Statistical Reports

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THE EVOLUTION, ORGANIZATION, AND MANAGEMENT OF BUSINESS

James Gemmell, Thesis (Ed.D.)
New York University, 1946

The purpose of this research project was to produce a textbook, directed to twelfth-grade pupils, that traced the evolution of business in the United States and described modern methods of organizing and managing a business enterprise.

Part I of the document, which deals with the evolution of business, is intended to enable pupils to evaluate the merits and the limitations of the private-enterprise system with objectivity. Part II describes the legal organization of business, the problem of getting the funds with which to organize a business, and the internal structure of business enterprises. Part III describes the typical problems of business management. Part IV is devoted to validation of the document.

Prior to the writing of Parts I, II, and III, the research worker collated the criteria which characterize an effective textbook intended for secondary-school pupils, with specific reference to the twelfth grade. From these criteria, the research worker built his own master list of nine criteria which guided him during the composition of each chapter in the document. Following the writing of each chapter, the criteria were applied to the contents, and revisions were made in the light of such applications.

The complete document was submitted to a group of experts for criticism and evaluation. A sample of the rating form which was submitted to these experts is included in the document. The experts were selected for their proficiency in the following fields with which the document dealt. The experts and their fields were:

Retail merchandising:	Dr. Charles M. Edwards, Jr., Dean, School of Retailing, New York University
	Mr. James L. McEwen, Assistant Employment Manager, L. Bamberger and Company, Newark, New Jersey
Management:	Dr. John G. Glover, Professor of Management, New York University
Economics & Finance:	Dr. George L. Leffler, Professor of Economics, The Pennsylvania State College
Teacher training:	Dr. M. Herbert Freeman, Head of Department of Business Education, New Jersey State Teachers College, Paterson
Textbook analysis:	Mr. Clyde I. Blanchard, General Editor, Gregg Publishing Company

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EDUCATION

ENTOMOLOGY IN GENERAL EDUCATION A DETERMINATION OF THE PRINCIPLES OF ENTOMOLOGY OF SIGNIFICANCE IN GENERAL EDUCATION

George Joseph Bergman, Thesis (Ph.D.)
New York University, 1946

This study was undertaken because of the investigator's realization that the current course in biology for general education fails to present the entomological content in an effective manner, and does not emphasize the social implications resulting from the activities of insects. The need was felt for a determination of principles of entomology which would meet the various criteria of general education, and thus demonstrate the value of their inclusion in a biology course for general education.

A list of frequently used textbooks and reference books of entomology was obtained from the heads of departments of entomology in nine colleges and universities. After careful analysis of these books and other entomological literature, a list of forty-six principles was obtained, each of which met certain criteria of a principle which had been drawn up by the investigator.

The principles were reviewed by a jury of eleven entomologists who recommended that two be omitted and eight be added. The resulting fifty-two principles were then checked against principles of biology. A tentative list of biological principles was obtained by combining the principles determined in three previous studies. These were checked against the wording of principles in four high school and four college textbooks of biology, which were considered to be representative textbooks by twelve chairmen of

high school departments of biology. Further modification and refinement resulted in a list of forty-five principles of biology which were compared with the fifty-two entomological principles. Certain biological principles were added, so that each principle of entomology in this study was related to, or subordinate to, a corresponding principle of biology.

A searching consideration of many articles and books dealing with general education disclosed various objectives or "criteria" of general education. Ten general criteria and fifteen specific criteria of general education were listed and sent, together with the fifty-two principles of entomology, to various specialists who were asked to match each principle against the criteria. Completed questionnaires were received from fourteen entomologists, six college biologists, ten chairmen of high school departments of biology, and seven science educators.

After tabulation and examination of the questionnaire results, the twenty-five criteria were listed in the order of their relative importance as regards the principles of entomology, as follows: (1) Has cultural value; (2) Understanding of basic scientific concepts; (3) Understanding and control of natural environment; (4) Development of interests; (5) Has practical application; (6) Contributes to reflective or critical thinking; (7) Economic welfare and security; (8) Has functional value; (9) Development of appreciations; (10) Contributes to adjustment to one's environment; (11) Application of scientific method; (12) Is useful in daily life; (13) Acquisition of skills and abilities; (14) Development of attitudes; (15) Physical and mental health; (16) Economic, social, and political problems of American life; (17) Choice of a vocation; (18) Appreciation of literature; (19) Development of a philosophy of life; (20) Oral and written communication; (21) Responsible citizenship; (22) Parenthood and family relationships; (23) Social and civic relationships; (24) Personal problems and personality

development; (25) Appreciation of, and self-expression in, art and literature.

By analysis of those principles for which criteria were selected and encircled by 50 to 74 per cent and 75 to 100 per cent of the specialists, the fifty-two principles were listed in the order of their relative significance for general education. It was seen that the principles of entomology having greatest significance for general education are those pertaining to man's economic welfare and health, and to methods of insect control. The principles of entomology having considerable value for general education are those which relate to the effect of the environment upon the activities of insects, abundance, distribution, and reproduction. Finally, the principles of entomology having the least significance for general education are those which describe basic anatomical features of insects.

The investigator recommends that, in teaching the principles of entomology, more attention be paid to social implications than to basic anatomy of insects. The listed principles may be used as a source of technically correct entomological statements, and as an indication of their relative importance, so that the teacher who is pressed for time may better ascertain which principles are to be stressed. Above all, it is recommended that the principles of entomology be included in a biology course for general education because they fulfill the criteria or objectives of general education.

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AN ANALYTICAL STUDY OF METHODS OF INSTRUCTION AT THE COMMAND AND GENERAL STAFF SCHOOL

Orville L. Eaton, Thesis (Ph.D.)
University of Kansas, 1946

This study was undertaken upon the order of the Commandant of the Command and General Staff School, Fort Leavenworth, Kansas, and conducted under the supervision of the School's Training Division. Three specific objectives were sought in making the study: (1) to determine whether a defensible theory of applicatory instruction used at the School could be discovered, (2) to analyze procedures and techniques of applicatory instruction in order to suggest modifications and refinements, and (3) to provide a source of information upon applicatory instruction for new instructors assigned to the School's Training Division and for military and civilian educators interested in methods of instruction used at the School.

Data upon procedures and techniques of instruction were obtained by observation of classes in session, through analysis of published material issued to both instructors and students, and from War Department manuals, Army regulations, Army circulars, and official publications of the School.

To provide a well-defined plan, a philosophy in terms of which the instructional methods of the School are analyzed, a chapter is devoted to establishing concepts concerning a basic psychology and a theory of instruction. The fundamental assumptions of educational philosophy used in this study are identified with pragmatic philosophy, which is also known as instrumentalism or experimentalism. This point of view is dominated by the principle of relativity and is based upon the general concepts of Gestalt-organismic psychology. Basic to this philosophy, as

to Gestalt-organismic psychology, is the concept that the human mind cannot deal with things in isolation. Learning is conceived as a process of gaining insights, and insights are assumed to be achieved through reflection upon challenging problems.

All instruction in the School is achieved through the application of principles of staff procedure in solving realistic staff problems. This method is known as applicatory instruction. The applicatory method was developed empirically, over the period of sixty-four years that it has been used at the School. Insofar as could be determined from data available, no attempt ever had been made to determine its philosophical and psychological bases.

Six forms of applicatory instruction are used at the School. These are the conference, exercise, map exercise, map maneuver, tutorial, and demonstration. Conferences and demonstrations are used to present the large body of data needed by a well-trained staff officer, with particular emphasis upon data used in subsequent instruction. In exercises, map exercises, map maneuvers, and tutorials, problematic situations were developed and presented to the students in published form. Following the presentation of general information and data, the students solved problems, either individually or in groups, that required the application of staff procedures and techniques.

A general conclusion, based upon the findings of the study, is that methods of instruction developed at the School may be considered as evidence supporting the pragmatic theory of instruction. The effectiveness of pragmatic educational theory, when applied to a comprehensive and complex program of instruction, is attested by the results attained with applicatory instruction at the Command and General Staff School. _____

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A HIGH SCHOOL AQUATIC PROGRAM TO MEET WARTIME NEEDS

William Edward Ferinden, Thesis (Ed.D.)
New York University, 1946

The Problem and its Importance

The problem was to develop a course of training in aquatics for High School boys to meet requirements brought to light by wartime experiences.

World War II brought out one very significant survival fact and that is that every member of the armed forces should know how to take care of himself in the water under the most trying of circumstances. This was true whether a man was a soldier, sailor, airman or civilian. The reasons for this statement were quite apparent if one considered the vastness of the global struggle in which we were engaged.

Time did not permit the military authorities to develop swimming skill sufficiently during basic training. The logical place then for this grounding in fundamentals was in civilian life.

Historical Background

Although the Greeks and the Assyrians realized the importance of swimming skills for military purposes it was not until the Nineteenth Century that it became an important part of the soldier's training. General Von Pfuel of Germany and Francis Leiber who established the first aquatic school in Boston in 1827 were pioneers in this field. World War I gave considerable impetus to the movement to give military personnel aquatic training. The interval between World War I and II was characterized by a phenomenal rise in all phases of aquatics.

Procedures

The first step in the project was to obtain aquatic data from the various bureaus at Washington, D. C. and the government printing office as well as to individuals in charge of aquatic training units at various training schools.

A total of thirty syllabi were submitted in response to the letters. There were ten duplications which left a total of twenty syllabi made available for the study. The branches of the armed forces from which aquatic data were received were:

United States Army
United States Navy
Army Air Forces
United States Coast Guard
United States Maritime Service
Navy Bureau of Aeronautics
American Red Cross

The content material embodied in the various syllabi was carefully studied and the basic essentials compiled. A jury was selected to evaluate the list of skills according to the following criteria:

1. That the skills be based on the needs of a nation at War.
2. That the skills be appropriate for high school boys.

The skills voted in the affirmative by the jurors were: Adaptation, Breath control, Floats, Stroke movements, Deep water test, Treading, Sculling, Sidestroke, Backstroke, Breaststroke, Crawl, Trudgeon crawl, Under water swimming, Swimming immobilized, Using artificial supports, Artificial respiration, Swimming with equipment, Rescue drills, Jumps from 10 ft. ht., Jump with blindfold, Sprint swimming and Endurance swimming.

Summary and Conclusions

A list of twenty syllabi was secured as a result

of forty-five letters sent to individuals in charge of aquatic training units. The survey of service syllabi showed a general uniformity in content material. The jury were unanimous in excluding from the course such items as swimming through fire and oil, jumping from 20 ft. hts.

Summary of Test Results

In order to determine the effectiveness of the program the students were retested at the end of the course. The results reveal the following pertinent facts:

That of 200 beginners in the non-swimmers course, 30 learned to swim in 12 lessons, the average for this group being 15 lessons. The improvement in under water swimming increased from an average of 35 ft. to an average of 55 ft.

Swimming with uniform was lengthened from 180 ft. to 300 ft. The addition of a gun to carry made little difference in these figures. Endurance swimming which the records showed was five minutes 30 seconds at the start of the course, was increased to an average of 14 minutes, 15 seconds at the end of the semester.

Sprint swimming time for a 100 yds. was lowered from 1 minute 54 seconds to 1 minute 39 seconds. Support through the use of trousers or shirts was improved from 7 minutes 50 seconds for an average, was increased to 13 minutes.

Recommendations

1. A greater recognition for standards of aquatic leaders.
2. Compulsory swimming in schools with facilities.
3. Certification of swimming teachers by State Departments.
4. Practice teaching in aquatics for physical education teachers.
5. Departments of Physical Education in colleges should increase their aquatic courses.

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DETERMINATION OF THE EFFECT OF TEACHING LITERATURE WITH EMPHASIS UPON INDIVIDUAL INTERPRETATION OF FIGURATIVE LANGUAGE

Theodora J. Koob, Thesis (Ph.D.)
New York University, 1946

Purposes of the Study

The purposes of this study were to determine the extent to which emphasis on the interpretation of metaphorical language develops general student ability to think critically; to determine to what extent observable changes occur in student responses to the usual testing devices of their school for the subject matter covered after training in interpretation; to advance the students' interpretative ability; to record analyzable data about interpretative response; and to contribute an attempt at determining the ways appreciations may be expressed.

Background of the Problem

Implications for the present investigation are found in the philosophy of John Dewey, in the non-aristotelian system of Alfred Korzybski and the general semanticists, and in the general bases of Gestalt psychology.

The development of multiple response to figurative language is based upon the idea that every individual has a discrete experiential background and may therefore be expected to interpret in terms of it. Another basic idea is that semantic reactions are non-elementalistic, that there is no separation of intellect and emotions, that response is psycho-physio-logical.

Experimental Procedure

The investigation was conducted in the Baldwin Long Island high school on the ninth and tenth year level with 125 students in the experimental groups and 107 in the corresponding control groups. The experimental groups studied the regular literary materials only through emphasis upon figurative language with the investigator; the control groups studied the same materials in the usual manner with their regular teachers. Both groups were tested before the experiment was begun and after it was ended with the Watson-Glaser Tests of Critical Thinking: Battery I, Form A and both groups took the regular school-tests for the material covered. The oral, group written, and individual written responses of the experimental groups were recorded for analyzation and appear in the Appendices of the study document.

Results of the Experiment

All experimental groups made better scores on the post-testing than the control groups (with the exception of one control group on the test on discrimination of arguments). The ability to generalize was not significantly affected; the ability to make valid inferences was definitely increased among the experimental groups; significant gains were made by two of the experimental groups in the other two areas tested: discrimination of arguments and recognition of assumptions. Age, sex, and grade level had no apparent effect upon the test results.

The experimental groups who had had no training in or use of the comprehension type question during the course of the experiment (forty regular English periods) did as well or better on the school-tests for the subject matter covered.

Variety in response gradually increased as students advanced in interpretative ability. Many students show evidences that they understand the overall implications in figurative language without appreciation of the full force of the metaphors involved.

Oral response permitted interpretative effects and was characterized by structural freedom and few grammatical errors. Written response improved as interpretative power grew.

Errors in interpretation included: circularity, confusions, literalness, reading errors, hedging, and stretched inferences.

Patterns of response included those of verbal expression: positive statement, recognition of negation, emphasis upon practicality, metaphorical expression; and those revealing recognition of semantic influences such as obvious contextual implications; contextual and experiential analogy; obvious connotational implications.

Students recognize, consciously or unconsciously, the influence of their experiential background. Expression of experience groups loosely under the recognition of the following types of experience: gregarious or social; physical and physio-sensual; psychological; environmental; and vicarious and intellectual. Overlapping occurs.

Conclusions and Recommendations

Emphasis upon the interpretation of figurative language has some positive effect upon general critical thinking ability and this suggests further study in this area.

Multiple student response may be analyzed in many ways. The process of interpretation offers a new area for continued study along many lines with implications for psychology, methods, and the language field.

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A SCHOOL PLANT PROGRAM FOR THE TYRONE PUBLIC SCHOOLS TYRONE, PENNSYLVANIA

Norman Miller, Thesis (Ed.D.)
New York University, 1946

The Problem and its Significance

The problem of this investigation is to determine the immediate and future school plant needs for the Tyrone Public Schools. Alterations in the present school plant and future school plant facilities reflect and grow out of the needs of the community, the recent development of education in Tyrone, and the ability of the School District to finance an adequate educational program.

The primary purpose of the study is to develop a guide for improving the school plant facilities of the Tyrone Public Schools for the years following the war.

Aspects of the Study

Community Study

The first aspect concerns a study of the community relative to its population trends; its industries; its cultural, civic, and religious growth;' and the future prospects of Tyrone as a community. The industries of Tyrone are diversified, including stone quarries, paper mills, chemicals, planing mills, railroad shops, dairies, wholesale houses, and graineries. With the possibility of the establishment of the Corning Glass Industry and the further expansion of the present industries in Tyrone, with the approval of a flood control project in Tyrone by the 77th Congress in the amount of $1,392,000.00, with the bequests of $180,000.00 and $150,000.00, respectively, for hospital and school plant facilities, Tyrone is likely to move forward commercially, industrially, culturally, and educationally.

History of Education

The second aspect of this study concerns the history of education of the Tyrone Public Schools. The school plant began with a log school building in 1852. By 1900, the present three elementary school buildings were erected. The present elementary school program is, therefore, housed in school buildings 50 or more years in age. The Senior High School was erected in 1911 and the Junior High addition, in 1929.

In recent years, the K-6-6 type of organization was adopted by the Tyrone Board of Education. Within the past five years, a number of changes have taken place within the educational program to include vocational education, work experience, guidance, redistribution of subject time allotments, the establishment of the kindergarten, and the extension of health service to include dental hygiene and a dental clinic.

The Educational Program

The third aspect of this study concerns the purpose, the objectives, and the proposed educational program. In Chapter V, the purpose and objectives of education were set forth as represented by some of the leading authorities in the field of education. The objectives of education proposed by the Educational Policies Commission, which include self-realization, human relationship, economic efficiency, and civic responsibility, are used in this study to determine suggestive changes in the educational program.

The proposed changes in the educational program concern the administrative direction of the school, the internal administration, the instructional program, health services, library service, and adult education.

Proposed School Plant

The fourth aspect of the study concerns the proposed school plant. The changes suggested in

the immediate and ultimate school plant reflect the purpose, objectives, and the educational needs of the schools and of the community. The immediate problem concerns major alterations and repairs in the Adams and Washington Grade School buildings and the replacement of the present Logan Grade School building by a modern elementary school plant.

With a stationary population in Tyrone, a decrease in the elementary school enrollment of 40 percent in the past fifteen years, a declining birth rate and stationary death rate, and with the percent of public school enrollment to the population of the community decreasing from 24.1 percent in 1933 to 17.4 percent in 1945, the present school plant is able to house the present and estimated school enrollment for the next few years.

School Finance

The fifth aspect of this study concerns the ability of Tyrone to finance an adequate educational program. This study has pointed out that the Tyrone School District is in good financial condition. Temporary loans have been paid since the school year ending July, 1943; the bonded indebtedness has been reduced to $25,000 and will be completely liquidated by January 1, 1946. Tyrone ranks tenth in indebtedness when compared with ten other towns of similar size. On February 1, 1946, the indebtedness of the School District was only 15 percent of the total indebtedness of Tyrone Borough. School receipts, particularly State and Federal appropriation and tuition, show trends for an increase within the next few years. With the expansion of the present industries in Tyrone, with the possibility of a new glass factory and the flood control project, the assessed valuation and the wealth of the community will likely increase.

Conclusion

This study is a guide to help formulate an immediate and ultimate school plant for the Tyrone School District. The primary purpose of making major alterations and repairs to the present school plant and in erecting new school plant facilities is to serve adequately the needs of the day-school pupils and out-of-school youth and adults. The school plant becomes not only a center for the day school students, but a community center for the welfare of all people of the community.

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DEMOCRATIC IMPLICATIONS OF REALISM IN HUMAN DYNAMICS AND EDUCATION

Adrian Tieleman, Thesis (Ph.D.)
University of Kansas, 1945

Abstract of a dissertation submitted to the Department of Education and the Faculty of the Graduate School of the University of Kansas in partial fulfillment of the requirements for the degree of Doctor of Philosophy, May, 1945, by Adrian Tieleman.

Currently there is much controversy regarding the acceptability of various philosophies for a democratic society. John Dewey, Boyd H. Bode, and others indicate that absolutisms are authoritarian and are therefore non-democratic. However, the persistence of realism in current educational and psychological literature suggests considerable acceptance of this type of absolutism. Moreover, Frederick S. Breed implies that a democratic society is best served by a realistic philosophy. In order to test Breed's claim, a study was made of two comparatively recent realistic publications: Edward L. Thorndike's Human Nature and the Social Order, and Franklin Bobbitt's The Curriculum for Modern Education. These books present an application of realism to human dynamics, society, and education.

It is noteworthy that Thorndike's conception of human nature implies fixity of the elements basic to behavior, and that human behavior is determined chiefly by inherent behavior patterns and their specific stimuli. He holds that modification of human nature is essentially a reorganization of these elemental responses through controlled repetition and rewards. This means that the individual does not act with foresight of consequences but in terms of stimulus-response bonds.

Thorndike applies his conception of the individual to society by observing that some persons are trustworthy because they have inherently good responses. In their hands he would place the reins of government. He predicts that major social improvements will develop from their unhampered impulses. Moreover, he would designate the conduct of the trustworthy as the standard for living. Thus Thorndike proposes a non-democratic society governed and standardized by a select few.

Bobbitt also assumes that the "good and able" should fix the universal design for living, and argues that their conduct should become the subject-matter of education. Assuming that learning is dependent upon repetition and rewards and that knowledge is derived through sense impressions, he proposes repetitious imposition of the "Good Life" in order to guarantee acceptable habits. But if in a democracy the chief purpose of education should be to assist learners to become capable of solving problems independently and cooperatively, then Bobbitt's conception of educational subject-matter and methodology suggests adherence to static authoritarianism rather than to democracy.

Realism, as represented by Thorndike and Bobbitt, implies that the individual is passive to stimuli and unable to act independently, with foresight of consequences. It assumes that the masses are unreliable and therefore should be governed by a select few who, by virtue of their inherent goodness, should control education and impress upon passive learners predetermined "correct" responses. If democracy implies equality of opportunity for each to have a voice in matters that pertain to him, and if education in a democracy implies development in independent and cooperative problem-solving, then realism is an inadequate philosophy for a democracy.

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THE STATE DEPARTMENT OF EDUCATION IN MISSOURI

Wallace Marvin Wilson, Thesis (Ph.D.)
University of Missouri, 1946

Major Adviser: W. W. Carpenter

Purpose: To trace, in part, the creation and development of the State Department of Education in Missouri and the influences exercised by it on public education in Missouri.

Scientific Approach: A survey was made of the biennial and annual reports of the State Superintendents of Missouri in order to obtain an insight into the nature of their work, and to reveal their major interests. A detailed study was also made of the various constitutions, proposed constitutions, major school codes and other legislative acts relating to the State Department of Education, or to those phases of public education concerning which it has shown much interest.

Summary:

(1) Schools were established on Missouri soil as early as 1774, and at the time Missouri was admitted to statehood there were many schools operating.

(2) Various acts of Congress relating to the territory that is now Missouri created a landed endowment for the support of public schools.

(3) The amount of legislation enacted by the territorial legislatures of Missouri, concerning schools was very meagre.

(4) The earliest school legislation of the State was concerned with the preservation of school lands.

(5) The first attempt by the legislature of Missouri, to establish a system of public schools, was in 1825.

(6) The Law of 1835 created the first State Board of Education.
(7) The State School Fund was created in 1837.
(8) The first State Superintendency was created by the Geyer Act of 1839. This office was abolished in 1841, and re-established in 1853. It was abolished for a second time in 1861, but was again re-established in 1865. The Constitution of 1945 provided for an appointive Commissioner of Education.
(9) The personnel of the office grew slowly until after 1900, but increased rapidly after that time.
(10) The duties of the State Superintendent were largely of a financial nature at first, but have expanded to include many phases of public education.
(11) Legislative restrictions concerning the qualifications of State Superintendents have been meagre. None have demanded professional qualifications.
(12) Much attention has been given by the various State Superintendents to the subject of improvement of instruction.
(13) To prevent the waste of Township and County School Funds has been a major goal of many State Superintendents of Missouri. Much sharp criticism has appeared in the annual reports regarding the methods of handling these funds.
(14) Various State Superintendents have advocated that limits on taxes for school purposes be removed, and that a general State educational tax be levied.
(15) Many State Superintendents have strongly urged the enlargement of school districts.
(16) The need for secondary education was recognized as far back as 1808, but few public high schools were established before the Civil War.

Conclusions:

(1) The action of Congress in reserving lands in the Missouri Territory, for educational purposes, was an important factor in bringing about a system of free, public education in Missouri.

(2) During the infancy of our State, the concept of free, publicly supported schools for all the children was a dream of our leaders, and developed slowly among the people.

(3) The many responsibilities that had to be assumed for the care of school lands and school funds represented one of the important reasons why the office of State Superintendent was created in 1839.

(4) The legislature was slow in determining the best method of choosing a State Superintendent, and in determining the proper term of office and salary.

(5) The duties imposed upon the State Superintendent, by legislative enactment, have increased with the demand for services.

(6) The State Superintendents have been leaders in many of the great movements that could be considered milestones in the educational progress of Missouri.

(7) The State Superintendents early caught a vision of State support for public education.

(8) The State Superintendents have been leaders in the movement to attain equal educational opportunities for all the youth of the State.

(9) Many of the State Superintendents have indicated a firm belief in the necessity of educating the people in order to perpetuate our democratic form of government.

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EDUCATIONAL PSYCHOLOGY

SOCIO-PSYCHOLOGICAL VECTORS IN THE BEHAVIOR AND ATTITUDES OF CHILDREN. III. TEACHER-PUPIL RELATIONSHIPS

Alice Marie Ewell, Thesis (Ph.D.)
Purdue University, 1942

While mental hygienists have claimed for some time that the fundamental characteristic of a good teacher is her ability to promote a feeling of security, independence and spontaneity in children, little experimental evidence has been offered to verify or refute this hypothesis.

This thesis, a part of a larger study to investigate acceptance status in normal children, proposed to analyze teacher-pupil relationships from the point of view of affective interaction between teacher and pupil.

A series of tests was given to 300 school children to measure social acceptance (as rated by classmates), presence of conflict in the form of discrepancy between personal behavior and the behavior and ideals of parents, teachers, classmates. In addition, each child was asked to rate his most liked and most disliked teacher on a series of 15 items.

From the large sample, a small sample of 31 boys, selected on the basis of acceptance status, was subjected to special analysis. This group was observed for a total of two hours, spread over an entire semester. The teachers of this group were also observed.

The ratings on teachers were found to be significantly different for the liked and disliked teachers, for boys and for girls. Girls tended to rate all teachers higher and showed less spread in their ratings than did boys.

In the same sample there were not significant differences in mean conflict scores or in observed behavior between those pupils well liked and those disliked. There were significant differences in amount of spread of scores; the disliked group were more variable in amount of conflict and in behavior. There tended to be consistent trends in the study. The disliked children tended to show more conflict; the liked children tended to be more spontaneous and active in a classroom situation. Teachers tended to dominate their pupils. Teachers who allowed more freedom in activity were better liked and pupils showed less restlessness in their classroom.

This study has two main values. It indicated the usefulness of an integrated approach to a large problem. It showed that it is possible to obtain experimental evidence in an area heretofore largely theoretical.

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ENGINEERING

A PHOTOGRAPHIC STUDY OF THE INFLUENCE OF FREE CONVECTION CURRENTS NEAR CRITICAL VALUES OF REYNOLDS NUMBER

William James Burich, Thesis (Ph.D.)
Purdue University, 1941

The purpose of the study was to examine experimentally 1) the type of flow adjacent to obstructions such as thermocouples and thermometers; 2) the turbulence of a liquid in an annular space under various conditions of temperature and velocity, and compare this with that expected from the value of Reynolds number; and 3) the degree of stratification of heated liquids flowing in horizontal annular spaces. The study concentrates on flows at velocities producing Reynolds numbers in the critical range, 2000 to 5000. While these are seldom encountered in industrial equipment, the flow characteristics produced by free convection currents could be observed most effectively at the lower limits of turbulent flow. The experimental evidence led to the following conclusions:

1. There exists a laminar layer of noticeable thickness adjacent to solid bodies, even when the average flow is well within the turbulent range. At a given Reynolds number the thickness of this layer may vary from a very small value up to about one-fourth of an inch, depending upon time and position and the state of flow.

2. Around obstructions immersed in the flowing fluid there exists a "stagnant" layer which will cause an appreciable time lag in the readings of temperatures by means of thermometers, etc.

3. Throughout the transition range of Reynolds number, a plug of turbulence appears in otherwise laminar flow. The frequency with which this plug

occurs increases as the value of Reynolds number increases.

4. During unsteady state flow of water, the free convection currents produced can create an entirely unexpected deformation of the velocity distribution curve. Free convection currents can produce a complete reversal of flow in one portion and turbulent flow in another portion.

5. An increase in the velocity of flow does not necessarily produce an increase in heat transfer when the flow is within the transition range of Reynolds number.

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A THEORETICAL STUDY OF
BROAD BAND RADIO FREQUENCY TRANSFORMERS

Samuel Gross Lutz, Thesis (Ph.D.)
Purdue University, 1938

This thesis was undertaken to develop a theoretical treatment of the communication transformer which, as a result of its freedom from mathematical approximations and serious electrical restrictions, may be applied to the broad band radio frequency transformer.

The full equivalent circuit of a communication transformer is a network of four or more meshes. Response equations obtained heretofore for these circuits have been exceedingly complex. An equivalent circuit is here presented as an equivalent unity ratio transformer operating between two ideal transformers. A system of ratio parameters is introduced which makes the numerical results of this investigation equally applicable to all transformers of this type regardless of the frequency range or impedance ratio. The transformer equations presented in this thesis have been derived without the use of any mathematical approximations and are extremely general in their application. These equations are presented in a very compact and convenient form for the tabular calculation of characteristic curves.

Expressions are given for the optimum damping factor and the transitional damping factor of broad band transformers. The case of a broad band transformer with negligible dissipation, interwinding capacitance and conductance, with primary and secondary circuits tuned to the same frequency and with the ratio of the terminating resistances equal to the square of the transformation ratio is termed the "basic" case. The characteristic curves for this

basic case are functions of only the coupling coefficient K, the damping factor D, and the frequency ratio Ω. Characteristic curve families are presented for the basic case for coupling coefficients of .1, .4, .8, .95 and .99 and for the most useful range of damping factors. These curve families illustrate the essential characteristics of broad bank transformers as distinguished from those of tuned coupled circuit transformers and audio frequency transformers.

The full equivalent circuit is shown to be equivalent to an inductive T network connected in parallel with a capacitance π network. The admittance matrix of the transformer has been obtained by adding the admittance matrices of these parallel connected T and π networks. From the admittance matrix and the terminating resistances are obtained more complete response and impedance equations than any previously available.

The effects of detuning, dissymmetry, interwinding capacitance, electrostatic shielding, and winding resistances are considered in much detail. Also considered are the effects of ferromagnetic core materials.

Equations are derived by matrix methods for studying the effects of a resistance-terminated tertiary winding. The addition of this winding may greatly increase the effective coupling of a transformer if the coupling to this winding is less than a certain transitional value.

This investigation helps to bridge the gap which has existed between the theoretical treatments of tuned loosely-coupled-circuit transformers and tightly-coupled audio transformers. The equations given are shown to agree with those derived by Chaffee, though derived and presented in a different form and applied in an entirely different manner.

Also included are an input reactance theorem and proof with some interesting impedance relationships, a section on impedance matching and reflection phenomena, and a bibliography of 259 items.

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AN ANALYTIC STUDY OF THE CHARGING CHARACTERISTICS OF MARX SURGE GENERATOR CIRCUITS

Carl Sherwood Roys, Thesis (Ph.D.)
Purdue University, 1933

The rapid increase during recent years in the amounts of power that must be transmitted over greater and greater distances has required the adoption of correspondingly higher transmission line voltages. As a result, the effects of lightning and switching surges upon system insulation, and its protection therefrom, has demanded more serious consideration. This has resulted in the establishment of high voltage laboratories where conditions in the field can be simulated at will and the effects of surges can be observed and analyzed.

Replacing earlier methods used to give extra high surge potentials, Dr. Erwin Marx in 1924 developed a gap switching circuit with which surge potentials of 10,000,000 volts were achieved at the Pittsfield works of the General Electric Company. There has been considerable forecasting as to the possible limits of the Marx circuit but no analytic study of the charging characteristics of the Marx circuit has ever been published.

It is the purpose of this study to make such a mathematical analysis. In carrying out the project, use is made of new applications of known methods, such as Carson's operational solution of recurrent networks and his integral equation solution for networks containing non-linear elements. However, original material includes (a) the determination of the expression for the total voltage across all of the condensers in the bank, (b) the solution of the

integral equation by means of a method of undetermined coefficients and especially (c) the transient solution of the rectifier problem by means of a Taylor expansion in terms of the first derivative with respect to time.

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LITERATURE, ENGLISH

SOME CHAPTERS ON SHAKESPEAREAN CRITICISM: COLERIDGE, HAZLITT, AND STOLL

Yao Shen, Thesis (Ed.D.)
University of Michigan, 1944

Coleridge and Hazlitt as Shakespeare critics have been severely attacked by Stoll. A study of the works of these three men from the following points of view, the creative process, the characteristics of the art object, and the effect of the art object on the spectator, shows that Stoll's opinions are mainly faulty.

According to the Romantics, represented by Coleridge and Hazlitt, the greatness of Shakespeare, the artist, lies in his wealth of native ability as well as in his superb technique of creation. He has an innate power of penetrating into the depth of things, a gift for seeing more in nature than an ordinary eye, and the protean skill of assuming the role of the various men and women he depicts. The process of creation is entirely under his conscious control. He obtains his material from observing nature, modifies such observations through meditation, and carefully selects suitable matter and an appropriate form. The quality of such observation, modification, and selection depends totally upon the excellence of the artist's conscious will, taste, and judgment. An art object thus created is the product of a mind subjectively and objectively balanced. It is not a mechanical copy of nature, but rather a creative imitation of reality in which there is truth to universal human nature. It is an individual entity characteristic of its own, yet possessing grounds that we all share in common. It has a moral that mirrors mankind in general and a style and a form that are appropriate to its matter. It is so

managed in its unfolding that the presence of probability leads the audience into "a willing suspension of disbelief."

Stoll, on the other hand, maintains that art is created by mechanical devices. Shakespeare omitted and shifted incidents in available material according to the taste of his time. To assure the emotional response of the audience, he used convention and tradition. A play such as Shakespeare wrote is, as a matter of art, a situation in which a character is engaged in a struggle with himself or other characters or other circumstances; he is motivated from the "without." The unity of the play is achieved through the subordination of this character to action and through the repetition of motifs. Art is a distorted picture of life, an imitation of reality limited by tradition. It pitches life either higher or lower than actual reality. The effect of art on the spectators is achieved by the use of contrast, accumulation and compression of events, repetition of theme and phrase, preparation, anticipation and suspense, convention, and the way poetry is presented.

Stoll's charges against the Romantics are that they believe in the omnipotence of genius, that they regard the art object as an imitation of life and the characters as separate copies of reality, that they insist on the presence of a moral idea in art, and that they work from a psychological presumption.

The two main reasons which account for Stoll's erroneous opinions and judgment are that he has neglected to make a thorough study of Romantic criticism and that his concept of art is fundamentally inappropriate to his subject and is at times self-contradictory. To the Romantics, a genius is a man who because of his ability to see and understand knows and sees more and therefore can create more truly than a common man. To them art is not a mechanical copy but a creative imitation. Whether art is an imitation of life or not is still an unsettled question in Stoll's mind. Stoll also persistently denies the presence of

a universal moral, which the Romantics highly value; and he quibbles that it is dramatic probability and not the Romantic concept of psychological probability that holds the emotional attention of the audience, as if human emotions can ever be studied apart from psychology. It is especially at this last point that the Romantics are superior. They have connected the artist with his art, the art object with its spectator, and the spectator with the artist. They have, as creator-spectator, entered into, understood, and exhibited the mind of the maker, the nature of the creation, and the thoughts and the reactions of the audience.

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PHILOLOGY

A SEMANTIC STUDY OF COGNATES IN SPANISH AND ENGLISH

Edith J. Kendrick, Thesis (Ph.D.)
University of Illinois, 1943

The purpose of this study is to establish the semantic identity, similarity, or dissimilarity of the cognates which occur within the 3000-word limit of Thorndike's A Teacher's Word Book of 20,000 Words and Buchanan's A Graded Spanish Word Book; to provide information as to the extent to which the meanings are equivalent; and to state the meanings which are different. No attempt is made to judge or discover the frequency or range of the meanings. By providing meanings and distinctions of meanings and by clarifying the parts of speech in a list of frequently used cognate pairs or groups, this study will, in so far as its scope allows, contribute to the great fund of materials which have preceded it and perhaps furnish the material for further studies.

The list[1] which serves as the basis of this study comprises a total of 2,037 words, both Spanish and English, cognate through their common Latin origin, included in the first 3000 of the Buchanan list and the first 3000 of the Thorndike list. Of these 2037 there are 981 pairs of words: i.e., one Spanish word cognate with one English word, such as PREPARAR--PREPARE. The other 75 words appear as derivative cognates: i.e., one or more additional Spanish or English words, derived from the 'pair'

[1]Marjorie C. Johnston, "Spanish-English Cognates of High Frequency," (The Modern Language Journal, XXV, 5 (February, 1941), 405-417.)

words, such as ARMAR, ARMA--ARM, ARMY, ARMOR. From the original dissertation by the same author[2] 102 Spanish and English words, cognate through other sources, chiefly Germanic, were added; all of these are also within the 3000-word limit of the Buchanan and Thorndike lists. Of this number there are 41 pairs and 20 derivatives. The combined total of all words to be considered is 2139, this number constituting 1119 entries, alphabetized according to the first word of the Spanish entry.

The first step was to look up the meanings of each Spanish word and each corresponding English word. For the Spanish meanings the principal source was Zerolo's Diccionario Enciclopédico de la Lengua Castellana with frequent reference to the latest edition of the Spanish Academy. Webster's New International Dictionary of the English Language served as the chief source for English meanings. From this point the following procedure was used to determine the identity, similarity, or dissimilarity of meanings:

1. Compare, wherever possible, a noun with a noun, a verb with a verb, an adjective with an adjective, etc.;

2. Check the meanings common to both words;

3. Note additional senses of the Spanish word not found for the English word;

4. Note additional senses of the English word not found for the Spanish word;

5. On the basis of the foregoing points, determine the classification of the pair or group of cognates;

6. Check questionable cases with supplementary references.

Classification on the basis of identical, similar or dissimilar meanings divides the words into

[2]Johnston, Cognate Relationships Between English and Spanish Vocabularies as a Basis for Instruction (Unpublished doctoral thesis, University of Texas, 1939).

four groups which are named List I, List II, List III, and List IV.

List I includes those pairs or groups of cognates whose meanings correspond exactly or differ in such very fine shades of meaning as to make the difference negligible. In List I it was deemed unnecessary to mention the meanings since they are obvious from the English word.

List II includes those pairs or groups of cognates which have one or more meanings in common plus additional senses in English or Spanish. Here annotations are made to show the origin of the cognates, the extent to which the meanings correspond, and especially, to state the meanings of the word in one language not found for the word in the other language. Following the etymological or source meaning, a "core" meaning is given. The core meaning is the basic concept common to both Spanish and English words. In cases where the etymological meaning has been retained and has become the core meaning of the modern words, no further mention is made of the core meaning.

List III includes those pairs or groups of cognates which have widely different meanings, although the words are from a common origin, and those pairs or groups of cognates in which the Spanish word is one part of speech and the English word another part of speech. Here the annotations show the source meaning of the cognates, the distinction, if any, in the parts of speech, and the meanings of the words.

List IV is entitled "Cognates Whose Etymology is Disputable and Those Which Are Not Semantically Comparable." Certain pairs or groups of words have disputable etymologies or sources which are not entirely clear: for example, ATACAR, ATAQUE--ATTACH, ATTACK. Certain pairs or groups of cognates have had such widely diverse developments that they are not recognizable as cognates either in form or meaning: for example. ENGAÑAR--GUN. A semantic

comparison of such words is of no practical value. In this List the annotations show the source meaning where it is clear and state the meanings of each word.

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FINNISH AND HUNGARIAN CASE SYSTEMS:
THEIR FORM AND FUNCTION

Thomas Albert Sebeck, Thesis (Ph.D.)
Princeton University, 1945

This dissertation consists of a description of the Finnish case system; a description of the Hungarian case system and system of suffixed postpositions; and a comparison of the two with a view to (1) historical reconstruction and (2) linguistic geography.

In Finnish, there are fifteen case suffixes, forming a system of five oppositions. The distinctive features are: location, direction, limitation, marginality, and closeness. A given case participates positively, negatively, or not at all in any given opposition or any given combination of oppositions. In order to understand the formal aspects of the case system, a preliminary discussion of progressive (vowel) assimilation and of stem types (nominal) is given.

In Hungarian, there are only five case suffixes, forming a system of four oppositions. The distinctive features are: location, direction, limitation, marginality, each case except the nominative participating in only one of the oppositions (positively), and the nominative bearing all four distinctive features, (negatively). In Hungarian, there is also a system of suffixed postpositions, seventeen in number. There are five distinctive features, four identical with the distinctive features of the case system, plus a fifth, closeness. The superessive is transitional between the two systems, which are interrelated in terms of specificity. The formal aspects of the case system and system of suffixed postpositions needs preliminary discussion and redefinition, which is here given.

In the conclusion, the Ostyak case system is briefly examined, and on the basis of the three Finne-Ugric systems discussed, the case system of the Finne-Ugric parent language is tentatively reconstructed. The need for more descriptive grammars in this field is stressed, for description of many structures is the premise for accurate reconstruction. Finally, the studies of Trubetzkey in the linguistic geography of case systems are referred to and the hope for further research along these lines is expressed.

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PHILOLOGY, ORIENTAL

THE OLDER INFLECTED FORMS SURVIVING IN THE MODERN JAPANESE WRITTEN LANGUAGE

Joseph Koshimi Yamagiwa, Thesis (Ph.D.)
University of Michigan, 1942

The object of this dissertation is to determine the extent of use of the older inflected forms found in certain specimens of the modern Japanese written language. These older inflected forms are sometimes used in formal speech and sometimes in certain petrified phrases that are used in the everyday colloquial. But in general they are found only in written materials, which in Japanese, as in other languages, tend to be more conservative and to preserve older linguistic forms.

The major share of attention has been given to the four inflected categories. These are the verb, the adjective, the adjectival verb, and the verb auxiliary or inflected suffix. In chapter i, the literary and colloquial paradigms set up by the Japanese grammarians Shinkichi Hashimoto, Yoshio Yamada, and Daizaburō Matsushita are examined. In chapter ii, these paradigms are criticized in terms of certain principles, mainly morphological, and a new set of paradigms is established. The critique of past treatments of the inflected categories is then extended to grammars of the Japanese language written in English. Chapter iii deals first with antecedent studies of the older inflected forms found in the modern Japanese written language, then discusses the scope of the forms treated in the present dissertation, and finally presents a statistical survey of the older inflected forms found in various specimens of the modern Japanese written language. These materials include:

(1) The national language readers, books XI and XII, in the editions of 1935 and 1937 respectively
(2) The novel by Yūzō Yamamoto entitled Shin-jitsuichiro (70th printing, 1939)
(3) The series of lectures by Yoshio Yamada entitled Kojiki Gaisetsu (1941)
(4) The newspapers Tōkyō Nichi Nichi and Yomiuri for April 19, 1940 (morning editions)
(5) 100 pages in the magazine Chūō Kōron for December, 1938 and July, 1941
(6) The scholarly work by Tsunetsugu Muraoka entitled Nihon Bunkashi Gairon (1938)

These materials contain approximately 91,930 inflected forms, of which 2782 or 3,02% belong to the older literary paradigms. The percentages of each of the six types of material are 0.37, 0.082, 0.428, 4.01, 6.72, and 9.16 respectively. It is thus shown that almost 97% of the inflected forms used in the modern Japanese written language are identical with those used in the colloquial. On the other hand, the variety of the forms is great enough to disprove the notion that the modern written language is "essentially similar to the spoken language of today."

Two lists are given for each of the types of material examined:

(1) The first list is of the older inflected forms occurring more or less obtrusively. The total number of such forms is approximately 130. These are the forms, then, that differ from those used in the colloquial. Because it seemed advisable to indicate the immediate syntactical environments in which these forms are found, a total of 226 entries is given.
(2) The second list consists of a total of 87 phrases and expressions containing older

> inflected forms. These phrases and expressions have become petrified through many years of use; mainly conjunctive and adverbial in value, they may in each case be regarded as single vocabulary items that are completely or almost completely idiomatic and not obtrusive in the modern written language.

The most frequently recurring older inflected forms are noted, as well as those that are rather unusual, from the point of view of grammatical norm. Agglutinations of literary and colloquial forms are likewise shown. The numbers of occurrences of the various older literary stems are then given in charts of the various paradigms. The following older inflected stem-types are found to occur most frequently:

(1) attributive stems
(2) the conditional-negative, conjectural, and perfective stems of the verb su, meaning "to do"
(3) the conditional-negative stem of the adjectival verbs
(4) the conjunctive stems of the verb auxiliaries shimeru or shimu and gotoshi
(5) the conclusive stem of the verb auxiliary mu or n

This dissertation arrives at its main conclusions chiefly through the statistical method. It concerns itself with the older inflected forms still used in the modern Japanese written language, with their syntactical environments, and with whatever seems significant from the point of view of frequency of occurrences.

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PHYSICS

A MAGNETO-OPTIC EFFECT IN THE X-RAY REGION

Harold Thomas Clark, Thesis (Ph.D.)
Purdue University, 1936

Magneto-optic effects in the X-ray region have been investigated using monochromatic radiation. For this purpose, X-rays were reflected from a crystal at a Bragg angle of 45° so as to be completely polarized. The state of polarization was recorded photographically by using a second crystalline aggregate as an analyzer and a photographic film in a cylindrical form about it.

Two different types of experiments have been carried out:

a). Characteristic X-rays from a cobalt target (CoKγ) were reflected from copper or nickel and passed through iron foils of different thicknesses and in different magnetic fields. By varying the thickness of the foil and the intensity and direction of the magnetic field, the Faraday effect could be investigated experimentally. No rotation was found although a rotation of 1° or more could have been detected.

b). Cobalt radiation was polarized by reflection from permalloy in different magnetic fields and recorded in the same way as above. The Faraday effect should exist here because of the penetration of the X-rays into the ferromagnetic material but no evidence of a rotation of the plane of polarization was found.

The results are compared with those of the experiments of Kartschagin and Tschetwerikowa and Froman and it is shown that the apparently positive

results obtained by them may be due to a lack of definition both in wave length and in azimuth of the radiation used.

Theoretical discussion shows that the equation of Froman is derived from the wrong assumptions and that in the form in which he gives it, yields a value only 1/10 of the value which he gives. Consideration of the mechanism of the production of X-rays shows that for radiation absorbed in the K-shell no difference is to be expected between iron and diamagnetic substances. On this basis and using the results of the dispersion theory, the possible rotation has been calculated and is found to be of the order of magnitude of 6' for the thickness of the foils and the strength of magnetic field which we have used. An effect as small as this cannot be detected by the photographic method.

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ARTIFICIAL RADIOACTIVITY IN CERTAIN ELEMENTS

Ray Lewis Doran, Thesis (Ph.D.)
Purdue University, 1941

The production of artificial radioactivity in three groups of elements has been investigated. The results include the verification of data previously obtained, and in addition, new information in each of the three following cases:

1. Magnesium

The alpha particle bombardment of magnesium produced three radioactive nuclei by reactions on the three stable isotopes of magnesium. Al^{28}, with a half-life of 2.35 minutes, was produced by an (alpha, p) reaction on Mg^{25}, a verification of work already performed by Amaldi and co-workers. Al^{29} was produced by an (alpha, p) reaction on Mg^{26}. The measurement of the period of 6.4 minutes for electron decay and the maximum energy of the beta ray spectrum as 2.4 $\pm$ .2 MEV was new information obtained in this investigation. The third nucleus, Si^{27}, was not investigated.

2. Konopinski Nuclei

The treatment used by Konopinski was applied to predict several new periods. Konopinski assumes the existence of certain regularities among the half-lives of the radioactive nuclei as functions of their atomic number. In families of nuclei, the members of which differ only in the number of alpha units they contain, the known half-lives are expressed as a function of atomic number. The regularities found are extrapolated so as to be able to make predictions about unknown and uncertain members of the family.

Using this hypothesis, curves of different families were drawn. The method was applied directly to nickel and to phosphorus. In nickel, the predictions indicated that Ni^{57} should have a half-life of about 2 minutes and Ni^{59} a half-life of approximately 36 hours. The different nuclear reactions carried out indicated that these values were correct. It was found that Ni^{57} had a period of 2.0 $\pm$ .1 minutes and Ni^{59} a period of 36 $\pm$ 1 hour. These results differ from the reported[41] 36 hour activity for Ni^{57}.

Phosphorus should have a nucleus P^{29} of half-life about 5 seconds, according to the curves of that family. Measurements of the activity were made after producing the nucleus by a new reaction, a (d,n) reaction. The period was found to be 5.0 $\pm$ .1 seconds.

3. Masurium

The well-known 67 hour activity of Mo^{99} was produced in a new reaction, zirconium plus alpha particles, from which the 6.6 hour activity of Mo^{99} grew. Alpha particle bombardment of molybdenum was shown to produce Ru^{95} and Ru^{97} with half-lives of 20 minutes and 100 minutes, respectively. Ru^{97} was produced by this reaction for the first time.

An alpha particle reaction on the single isotope of columbium produced two periods of decay. These periods were assigned to two isomeric states in Ma^{96}, one of which decays by means of a positron activity of 2.7 hours and the other by means of a negative electron activity of one hour. Because of the fact that the energy of the one hour activity was about 30,000 EV, and no X-rays were detected, the assumption of two states of Ma^{96} was thought most plausible. Each state is thought to decay by a different process, the one state by positron emission of maximum energy .9 MEV to Mo^{96}, while the other state decays to Ru^{96} by the emission of negative electrons.

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HEAT TRANSFER AND VAPOUR DIFFUSION IN THE DEHUMIDIFICATION OF AIR

Walter Robertson Elliot, Thesis (Ph.D.)
Purdue University, 1941

While the heat transfer from a hot surface to a stream of air in viscous flow can be computed by means of empirical formulae which have been experimentally established, the calculation of heat flow in the opposite direction is one for which there is as yet no equally satisfactory solution. One purpose of this study was to begin the investigation of this problem using a small vertical heat transfer surface, with the expectation that subsequently, further work could be done on larger apparatus.

In addition, the rate of dehumidification of air in streamline flow was to be determined, and the results correlated with previous work.

The heat transfer surfaces used in this initial set of experiments consisted of two 3" x 12" brass plates, which formed two sides of a rectangular box. The other sides were of lucite. The inside surfaces were kept at constant temperature by means of a constant supply of cooling water, and heated air passed in viscous flow across the outside surfaces. All temperature measurements were taken with thermocouples, and the temperature of the air stream was very accurately controlled by a thermionic tube temperature control.

Actual psychrometric properties of the air were measured using thermocouples, and by actually sampling the air before and after it passed the heat transfer surface.

The rate of heat transfer from a stream of heated air to a cooled vertical surface was found

to be much less than the heat flow from a hot surface to a cool air stream for the same average temperature difference.

The rate of heat transfer by natural convection from a cool surface was found to be

$$H = .02(\Delta t)^{1.82} \text{ B.t.u. per hour per sq. ft.}$$

This equation should not be applied to any conditions other than those considered until further experimental work can be done using larger heat transfer surfaces.

The rate of condensation has been expressed as a function of the partial pressure difference of the vapour only by the equation

$$W = 0.12(e_m - e_s)^{1.35}$$

where

W = pounds of condensate per hour

e_m = partial pressure of vapour in the gas stream, inches of mercury.

e_s = partial pressure of vapour at surface temperature t_s.

As diffusion occurred to the flat surfaces in a fairly large tube, and as the longitudinal vapour pressure gradient along the surfaces was small, it is possible that this equation will be found to have a more general application than has appeared in this thesis.

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DISINTEGRATION BY ALPHA--PARTICLES

John Ogden Hancock, Thesis (Ph.D.)
Purdue University, 1940

Two radioactive isotopes of rubidium are formed when bromine is bombarded with alpha particles. When the rubidium formed in this reaction is separated chemically it is found to decay with half-lives of 20 minutes and 6 1/2 hours. When krypton is bombarded with deuterons a rubidium isotope of 20 minutes half-life is also formed. It is concluded that this half-life is characteristic of Rb^{84} formed in these experiments by the reactions

$$_{35}Br^{81} + {}_{2}He^{4} \longrightarrow {}_{37}Rb^{84} + {}_{0}n^{1}$$

$$_{36}Kr^{83} + {}_{1}H^{2} \longrightarrow {}_{37}Rb^{84} + {}_{0}n^{1}.$$

It is found that Rb^{84} emits negative electrons. The second rubidium activity formed from bromine is then assigned to Rb^{82} formed by the reaction

$$_{35}Br^{79} + {}_{2}He^{4} \longrightarrow {}_{37}Rb^{82} + {}_{0}n^{1}.$$

and emits positive electrons. From consideration of the sign of the charge of the particles emitted, the 4.8 hour activity obtained from the deuteron bombardment of krypton was assigned to Rb^{83} and the 25 day activity from the same source has not been assigned. Bombardment of a one gram sample of RbCl with fast neutrons gave no activity though it had been hoped to form Rb^{84} by this reaction. The maximum energy of the positrons from Rb^{82} has been found to be approximately 8 KEV by both cloud chamber and absorption measurements.

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Microfilm copy of complete manuscript 45 pages at 1 1/4 cents, total cost $1.00, paper enlargements 5" x 8", at 10¢ per page. Available from University Microfilms, Ann Arbor, Mich.
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A NEW TYPE OF GEIGER COUNTER

Thomas Gerald How, Thesis (Ph.D.)
Purdue University, 1938

Fundamental considerations have been reviewed which explain the action of a tube counter. Two conditions are postulated for ideal counting. The stopping of the counter discharge by space charge, external resistances, and Neher-Harper circuits is discussed. The difficulties involved in the attainment of the "retarded discharge" are pointed out and explanations suggested for some of them. In the case of large screen anode tube counters these difficulties are particularly acute.

A multiple wire counter is described which operates satisfactorily over a range of 50 volts or more. It allows a radioactive sample to be placed inside the counter, thus providing an increased sensitivity due to the increase in solid angle. Slow alpha and beta-rays do not have to pass through any absorbing window.

Results of measurements on potassium, rubidium, uranium, cobalt, and radium beta-rays, uranium and samarium alpha-rays and radium gamma-rays are included. Determinations have been made of the radium content of three types of mineral water from Saratoga Springs, New York, and from two types of Michigan brine deposit. Several precipitates from the Saratoga water were measured and these compared favorably with measurements made elsewhere. The results obtained with the beta-ray activities indicate that the counter is capable of producing consistent results, the accuracy of which is defined only by the probable error caused by statistical fluctuations. The efficiency of the counter to gamma-rays is about 0.35%, of alpha-rays 40%, and of beta-rays from 25%

to 40%, depending on their energies. Since the efficiency increases (or at least it does not decrease) as the energy decreases, the counter will be sensitive to extremely slow beta-rays which probably exist in radioactive substances but which have never been detected because of the absorption which occurs in the counter. These two advantages, the increase of solid angle and the elimination of an absorbing window, offset the loss in efficiency created by the departure from cylindrical symmetry. Its sensitive response to the artificially induced activity of cobalt proves its usefulness in the difficult task of detecting the unstable C_{14} isotope which may be used in an innumerable number of chemical and biological indicator experiments.

The cooperation of several people and organizations in this project is gratefully acknowledged. Dr. Oscar Baudisch of the Saratoga Springs Commission, Dr. J. R. Risser of Purdue University, Prof. R. D. Evans of the Massachusetts Institute of Technology, Dr. Robert Livingston of the University of Minnesota, Prof. B. S. Hopkins of the University of Illinois, J. D. Hanawalt of the Dow Chemical Co., generously supplied materials used in this research. A grant from the American Academy of Science provided financial support in the purchase of equipment.

The work was under the supervision of Prof. Lark-Horovitz, who initially suggested the problem. His helpful criticism in the research project and in the writing of this thesis is deeply appreciated.

The apparatus was exhibited at the Annual Science Exhibit of the American Association for the Advancement of Science in 1937. A preliminary report of this work was presented at the Indianapolis meeting of the American Physical Society, December, 1937.(35)

Publication No. 842

Microfilm copy of complete manuscript 84 pages at 1 1/4 cents, total cost $1.05, paper enlargements 6" x 8", at 10¢ per page. Available from University Microfilms, Ann Arbor, Mich.
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X-RAY SCATTERING FROM LIQUIDS

Emery Parker Miller, Thesis (Ph.D.)
Purdue University, 1936

Using a new type of x-ray tube with high intensity, a method has been worked out to obtain the diffraction patterns of liquid films supported by surface tension in a wire loop.

Oil and glycerine have been investigated at different temperatures. It has been found that glycerine, solidifying as a glass, exhibits a diffraction pattern of approximately the same shape at different temperatures. This indicates that the grouping in liquids is determined by molecular packing only and that there is no tendency for crystal nuclae to grow with decreasing temperature.

A graphical and numerical method has been worked out for the Fourier analysis of x-ray diffraction patterns of monatomic liquids.

This method has been applied to the analysis of liquid salts particularly KCl and LiCl at a few degrees above their melting points. It has been found that the diffraction pattern of KCl can be interpreted as due to a structure of the same coordination number as in the solid: any ion has six neighbors of opposite charge but this coordination is not maintained accurately beyond this first shell. This conclusion is substantiated by the fact that there is a much smaller number of second nearest neighbors as compared with the same range in the crystal.

The comparatively sharp diffraction pattern of LiCl has been interpreted as being due to the fact that the chlorine ion is mainly responsible for the scattering. This ion also determines the packing.

An analysis carried out under these assumptions leads to an ion concentration at the distance where it would be expected on the basis of a coordination number of six. The number of nearest neighbors at this distance is also in agreement with the number to be expected from this coordination.

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Microfilm copy of complete manuscript 104 pages at 1 1/4 cents, total cost $1.30, paper enlargements 6" x 8", at 10¢ per page. Available from University Microfilms, Ann Arbor, Mich.
Library of Congress Card Number Mic A47-78

THE STRUCTURE OF AMORPHOUS AND STRETCHED RUBBER

Clarence Merton Parshall, Thesis (Ph.D.)
Purdue University, 1941

X-ray investigations of rubber have been carried out for both amorphous and crystalline material. The amorphous material shows a pattern like a liquid with diffraction rings at $\frac{\sin\theta}{\lambda}$ values of 0.1055, 0.222, 0.417. This pattern was obtained in a vacuum camera of 8.6 cm. diameter with molybdenum radiation reflected from a rock salt crystal. The film holder carried calibration marks every 20° so as to eliminate errors due to shrinkage of the film.

The Scherrer expression correlating half width and particle size leads to crystallites of the order of 80 A°.

The pattern was obtained by using pure latex, poured on glass, dried and mounted stress free in the camera. The samples were in the form of flat sheets 1.5 to 2.0 mm. thick.

The most interesting problem in the structure of rubber is the question of what happens in the stretching process. To investigate this problem the maximum elongation to which latex can be stretched at room temperature without crystallizing was determined. For this purpose the sample was put in a specimen holder which allows the determination of the amount of stretch and which can be mounted in a reproducable fashion in the camera. Diffraction patterns have been obtained at elongations of 100 per cent, 200 per cent, and 250 per cent. At 275 per cent elongation the sample becomes crystalline as indicated by the appearance of diffraction spots on the equator.

To interpret the diffraction patterns, fourier analysis has been used to obtain a radial distribution. With substances such as rubber and other light organic materials such an analysis presents serious experimental difficulties due to the fact that (a) the large amount of hydrogen present produces a large amount of incoherent scattering at large angles and (b) because the scattering power of the material is so small as to become comparable, at large angles, with the accidental scattering. It is, therefore, not uniquely determined where one should cut off in the experimental curve and assume independent coherent and incoherent scattering. By trying several ranges and matching the experimental and theoretical curves in different ways one can obtain quite different results. This is due to the fact that the curve Si(s) which is to be analyzed includes S, increasing with $\frac{\sin \theta}{\lambda}$. Any small area in the experimental scattering curve at large angles is thus made comparable with the large area due to well defined rings.

In the case of rubber where it is known that we are dealing with a chain-like structure, that means two first neighbors, it is possible to determine empirically where to cut off so as to get the correct number of first neighbors. In other cases, and this method has been used throughout this work, it is possible to match over a range by matching areas under the experimental and theoretical curves. For the actual analysis a scheme of calculation developed by Danielson and Ianczos has been used.

Visual comparison of the experimental curves does not show any striking differences. The height of the first peak is somewhat changed, increasing with increasing stretch, and the shape and positions of the outer rings are slightly changed. Three different experiments have been carried out for each elongation and the curves given are the average values.

The Fourier analyses of the curves reveals the details of the structure. In the stress-free state we find 1.9 neighbors at a distance of 1.52 A° and 2.86 neighbors at a distance of 2.54 A°. There is a slight indication of a concentration at 3.5 A° and at 4.24 A° and a considerable hump at 5.06 A°. The concentration at 5 A° is responsible for the main peak in the experimental curve and from other organic substances, we know that this must represent distances between neighboring molecules.

The second peak is better resolved than in the analysis of smoked sheet by Simard and Warren and this checks with our own results for that material.

As stretching increases, the second peak becomes better resolved and at an elongation of 250 per cent, this peak is almost completely resolved. At the same time the concentrations beyond second neighbors are quite distinct. It is also to be noticed that the number of second neighbors decreases and that the peak itself appears at a shorter distance.

To understand this change we want to recall the structure of the rubber chain as accepted from chemical and other evidence. Taking the bond angles as 109° 28' and 125° 16' and single and double carbon bond distances as 1.54 A° and 1.38 A° respectively, one calculates two first neighbors at 1.51 A°, in agreement with position and area of the first peak. There should be 2.4 neighbors at a distance of 2.56 A° but this number will always be larger because of the contribution of interpenetrating third neighbors. As the stretching increases the rubber molecule is no longer able to coil and uncoil freely and change its configuration. Therefore, the contribution of the third neighbors to the second peak becomes smaller and the position of the third neighbors themselves becomes more definitely fixed. The distance of 3.33 A° corresponds exactly to the average value between smallest and greatest distances of third neighbor; 3.33 A° observed and 3.32 A° calculated.

Hence, we conclude that the results of the investigation indicate quite definitely that we do not have an extended molecule in the unstretched rubber but have instead a folded molecule, which, by rotation about the single carbon bonds, is itself capable of elongation. In the process of stretching, the molecule loses part of its freedom to change configuration by coiling and uncoiling, the process of fixing definite positions being evidenced by the sharpening of the peaks in the radial distribution curve.

I wish to express my deep appreciation and sincere thanks to Dr. Karl Lark-Horovitz and Dr. E. P. Miller for their assistance during the course of this investigation. It has been their guidance and criticism that has made the completion of th. work possible.

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POLITICAL SCIENCE

PETER NORBECK: PRAIRIE STATESMAN

Gilbert Courtland Fite, Thesis (Ph.D.)
University of Missouri, 1945

Peter Norbeck, who became South Dakota's foremost statesman and politician, was born in Dakota Territory in 1870. Young Norbeck experienced the rigors of pioneer life and acquired only the barest rudiments of education. He first distinguished himself by constructing an artesian well-drilling machine which made possible a small-bore well at a very reasonable cost, thereby solving one of the major problems facing many Dakota farmers. Artesian wells were drilled in Dakota as early as 1880, but the cost varied from three to five thousand dollars, making it prohibitive for the average farmer to own one. Norbeck drilled them for a few hundred dollars. In 1901 Norbeck formed a partnership with Charles Nicholson and this became the largest artesian well-drilling firm in the Midwest. At one time Norbeck and Nicholson had over forty well-drills in operation and by 1924 they had completed some twelve thousand wells.

Soon after the turn of the century Norbeck joined the progressive Republicans in his state. He became a follower of Theodore Roosevelt and during his long political career seldom wavered from Roosevelt's middle-of-the-road progressivism. In 1908 he was elected state senator on the progressive Republican ticket. After serving three terms, he was elected Lieutenant Governor in 1914 and Governor two years later--the first native born South Dakotan to hold that office.

Having been in close contact with farmers and their problems in his well-drilling business, Norbeck

championed their interests. As Governor he was determined to inaugurate policies helpful to agriculture and he believed that the state's entrance into certain types of business would alleviate some of the abuses from which the farmers suffered. He sponsored a state rural credit plan, a system of state hail insurance, a state coal mine and a state-owned cement plant. To a great extent he was responsible for a state bank guarantee law adopted in 1915. Norbeck's actions may have been influenced in part by the Nonpartisan League of North Dakota, but he was a firm believer in extending governmental powers to solve economic problems. He reflected the spirit of agrarian discontent in his section. Although his rural credits plan was a costly failure, he never lost the support of South Dakota's voters.

In 1920 Norbeck was elected United States Senator. In Washington he became a strong spokesman for the farmers, an accredited voice of protest against "agricultural inequality." He fought vigorously for the McNary-Haugen bill and later was a leading sponsor for the domestic allotment plan of farm relief which became the basis of the New Deal farm program. By 1932 Norbeck was one of agriculture's outstanding spokesman in Washington.

One of Norbeck's principal achievements during his senatorial career was the direction of the New York Stock Exchange Investigation in 1932-33. More than any other man he is responsible for keeping the inquiry alive in the face of strong public and congressional opposition. Norbeck was determined to expose existing abuses and obtain corrective legislation.

Norbeck was primarily responsible for the Migratory Bird Conservation Act of 1929, one of the most important wild-life conservation measures of the postwar decade. His greatest weakness as a Senator was his lack of consistent interest in foreign affairs.

Norbeck always displayed a healthy independence in politics and often refused to work with his party.

He disagreed sharply with the conservative republicanism of the 1920's and early 1930's and finally accepted many of the policies of Franklin D. Roosevelt, supporting the President for re-election in 1936. Norbeck had been a progressive and an advocate of the extension of governmental powers for over a quarter of a century. His support of Roosevelt in 1936 was the logical consummation of his long and active political career.

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Microfilm copy of complete manuscript 523 pages at 1 1/4 cents, total cost $6.54, paper enlargements 6" x 8", at 10¢ per page. Available from University Microfilms, Ann Arbor, Mich.
Library of Congress Card Number Mic A47-36

TECHNIQUES OF POLITICAL PERSUASION USED BY CERTAIN CONGRESSMEN FROM SELECTED STATES, 1921-1946

Raymond Grann Lloyd, Thesis (Ph.D.)
New York University, 1946

I. The Problem

The problem of this study was to establish the basic techniques of political persuasion used by certain Congressmen; and to determine the inter-causal relationships, if any, between the economic and political conditions and factors of their states and their use of the techniques of political persuasion mentioned above.

II. Delimitations of the Problem

This study was delimited to: (1) the twenty-five year period 1921-1946; (2) certain Congressmen from states requiring the payment of a poll tax as a prerequisite for voting, as of the 1944 presidential election; (3) certain Congressmen who have not only been successful in gaining or retaining but filled a seat in Congress for at least six consecutive years during the period studied.

III. Method of Procedure

Through historical research, based on primary sources, the basic techniques of political persuasion used by the Congressmen involved were determined. Through historical research, based primarily on secondary materials, the economic and political conditions and factors of their states that are pertinent to this study were established. An analysis of the former in the light of the latter revealed the inter-causal relationships between their use of

the techniques and the economic and political conditions and factors in their states.

IV. Significant Aspects of the Study

Part I--The White Supremacy Technique

The establishment of a poll tax and other restrictive requirements as prerequisites to the suffrage in the poll tax states have so effectively debarred the Negro from the suffrage that although Negroes live in the poll tax states they are not the constituents of the Congressmen from those states. Hence, Congressmen from the poll tax states have been able to make political capital of white supremacy.

On the one hand, they have not been faced with the political expedient of either cultivating the good will of the voteless Negroes or serving them. On the other, they have been at liberty to present the alleged "African menace" so graphically from the hustings and on the floors of Congress as to fill many Americans, imbued for generations with the alleged necessity of maintaining white supremacy, with fear. And by offering themselves as protectors of white civilization they attempted to convince their constituents that unless they were retained as their Congressmen white American, especially the white South, would become the wretched victim of an unbearable catastrophe--"Negro domination."

Part II--The "Strict" Construction Technique

The construction placed upon the powers and functions of America's national government today is vastly different from that placed upon them when it was first inaugurated. It has been transformed by the perennial struggle between two schools of political thought--one advocating a "strict" construction of the Federal Constitution, the other a "liberal" construction of it--and the never ending pressures exerted by the needs of an ever-expanding complex society.

The Civil War was the turning point in the evolution of the construction placed upon the authority

and functions of the national government. It made possible the new interpretation of "strict" construction of the present day--sectional or minority rights, not states' rights. However, it often operates under the aegis of states' rights.

Part III--The Super-Americanism Technique

Such nativistic movements and protagonists as those considered in this study are not important historically because of what they accomplished or attempted to accomplish. They are of historical significance because they were symptoms of hostility to certain elements of the American population--hostility that still exists.

Super-Americanism is an old dilemma and a difficult one. In the early years of American nativism religious antagonisms were intense. Today nativism is mainly concentrated in economic, racial and social conditions and biases. In the former period it was feared that the immigrant would become a citizen too easily and too quickly. Today it is feared that the immigrant will not become a citizen at all;[1] that he is an agent for a foreign power.

V. Bibliography

Approximately one hundred seventy-five books, periodicals, newspapers, official government records and miscellaneous sources were consulted in planning and carrying out this research.

[1]George M. Stephenson, A History of American Immigration, p. 97.

Publication No. 833
Microfilm copy of complete manuscript 429 pages at 1 1/4 cents, total cost $5.36, paper enlargements 6" x 8", at 10¢ per page. Available from University Microfilms, Ann Arbor, Mich.
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PSYCHOLOGY

A COMPARATIVE STUDY BETWEEN CERTAIN CONCEPTS AND PRINCIPLES OF MODERN PSYCHOLOGY AND THE MAIN WRITINGS OF JOHN STEINBECK

Eugene L. Freel, Thesis (Ph.D.)
New York University, 1946

The study was concerned with certain concepts of modern psychology in relation to the writings of the contemporary American novelist John Steinbeck.

The emphasis given to psychology by modern novelists and the growing interest in the subject itself on the part of the public has indicated the desirability for critical analysis of psychological concepts in the writings of contemporary novelists. Some research along this line has already been accomplished, chiefly with the relationships between novelists and Freudian psychology.

As all good novelists, John Steinbeck is concerned with the study and depiction of human nature in its relationships with people and society. He is interested in portraying the behavior of individuals, their conflicts, adjustments, and goals. Moreover, Steinbeck is a scientist, deeply concerned with ecology and biology. A portion of the study sought to determine if his ecological and biological beliefs were related to the thinking of modern psychologists.

In seeking to identify concepts of modern psychology that could be considered representative of the principal contemporary psychological thought in America, Raymond Holder Wheeler's Laws of Human Nature were analyzed and compared with concepts of field theory psychology. These laws were held to constitute a general summary of field theory psychology, and also appeared to be related to many of the concepts of Freud. Wheeler's laws were determined to constitute a basic philosophy of nature,

being based on the findings of modern biology, ecology, and physics.

Against this background the writings of John Steinbeck were analyzed. Certain relationships were deemed to exist between his works and Wheeler's laws. Steinbeck's familiarity with modern physics, especially the theory of relativity, appeared to be related to concepts of Wheeler and field theory psychology.

Steinbeck's ecology, a subject which he discusses to length in Sea of Cortez, was determined, as others have held, to have been carried over in some instances to certain of his novels, particularly In Dubious Battle and The Grapes of Wrath. These ecological ideas were considered to possess relationship with some of Wheeler's Laws of Human Nature.

Steinbeck's conception of the "unit animal", although somewhat fanciful, appeared to have relationship with the "collective or group mind" theory of LeBon, and to the explanation of crowd behavior by McDougall and Brown.

The two most important sociological novels of Steinbeck, In Dubious Battle and The Grapes of Wrath, were compared with the psychological concepts of J. F. Brown. The latter's theory of social psychology accepts the conclusions of organismic and field theory psychology, and applies the results of Lewin's topological psychology to the description of the social field. Brown's concepts were considered to offer a logical explanation for many of Steinbeck's ideas about economic depression, industrial conflict, family relationships, and individual personality.

John Steinbeck evidences a decided liking to depict characters of varying degrees of abnormality. This continues from his earliest writings to his latest. Although the characters are not studied as case histories with inquiry into causes and treatments, the author indicates that he understands the psychological behavior underlying the portrayals. In some

instances the behavior appears explainable in terms of both Freudian and field theory psychology.

Finally, the results of the study add weight to the conviction that John Steinbeck is a careful planner of his work. Much of this planning can be attributed to his scientific background.

To date, there have been few critical studies made of John Steinbeck. The conclusions of the study should aid in the formation of a clearer picture of the author. The psychological concepts identified with his writings should help in an understanding of many of the characters and situations in his books.

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THE CONSTRUCTION AND STANDARDIZATION OF THE PURDUE MECHANICAL ASSEMBLY TEST

Maurice R. Graney, Thesis (Ph.D.)
Purdue University, 1942

The purpose of this investigation was to construct a new test of mechanical ability which did not possess certain faults characteristic of earlier tests of this kind, and to standardize its administration and scoring.

The test consists of a series of nine problem boxes of standard size. In each box a mechanism may be assembled in such a way that a mechanical action takes place. The first problem box contains sub-test X which is an introductory unit. The eight sub-test units, A-1, A-2, A-3, A-4, B-1, B-2, B-3, and B-4, which compose the test situation are divided into two forms of four units each. The order of administration, in each form, is from the simple to the complex. The test embodies certain characteristics, i.e., sturdy, precision construction, and non-stereotyped problem situations, which appear to be improvements upon those tests which were its prototypes. Complete working drawings showing the construction of each test detail as well as correct test assembly for each unit have been made.

The eight sub-tests included in the test situation give a sufficient number of assembly tasks to yield a reliability of 0.77. This was determined by correlating performance on the first four sub-tests against performance on the second four sub-tests. In all 338 total test scores were used for this calculation, the number being made up of 128 college engineering students, 98 machinists, 48 machinists' apprentices, 43 students in a vocational high school, and 21 unclassified adults. For the first four of

these groups, performance on the test was correlated with some index of success in the activities in which the groups were engaged. These indices were grades in shop and drawing, merit ratings, instructor ratings, and supervisor ratings. Corrected coefficients of correlation ranged from 0.20 to 0.51.

A factor analysis of the sub-test intercorrelations revealed the presence of two factors. One of these was identified as mechanical insight, the other as mechanical experience. In these calculations scores from 203 persons selected from all the groups tested were used.

The general findings of the study indicate that the test may be too difficult for students in the secondary schools, but should prove useful in vocational guidance and employee selection on the adult level.

Publication No. 868
Microfilm copy of complete manuscript, 115 pages at 1 1/4 cents, total cost $1.44, paper enlargements 6" x 8", at 10¢ per page. Available from University Microfilms, Ann Arbor, Mich.
Library of Congress Card Number Mic A47-75

ANALYSIS OF ELEMENTAL MOTION TIME VALUES IN A SIMPLE ASSEMBLY OPERATION

Clifford E. Scott, Thesis (Ph.D.)
Purdue University, 1942

Techniques of motion study analysis were used in this study. The records of one-hundred untrained subjects were analyzed.

1. A practical and convenient method of timing and recording elemental motions was developed. The apparatus consists of an electronic timer which gives a graphic record showing the time of the several basic parts of the motions.

2. There are significant individual differences in the elemental motions of a simple assembly task requiring the use of the fingers, wrist, and forearm.

3. The relationship between performances of different elemental motions was quite low.

4. When analyzed by factor analysis, the relationship could be accounted for by three factors. The relationship corresponded to the gross muscle group used in performing the elemental motion. They were (a) finger, (b) wrist, and (c) forearm.

5. The use of the total score alone in this manipulative task ignored individual elemental motions, and was determined primarily by the motions which require the most time for completion in the task and have the greatest standard deviation. Motion study analysis converted the task investigated into a potential test battery.

6. The technique of motion analysis seems to provide a useful tool in the field of aptitude testing. It offers a method of matching tests with industrial jobs and, as a research method, may reveal fundamental information concerning manipulative skill.

Publication No. 860
Microfilm copy of complete manuscript 49 pages at 1 1/4 cents, total cost $1.00, paper enlargements 6" x 8", at 10¢ per page. Available from University Microfilms, Ann Arbor, Mich.
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ZOOLOGY

STUDIES ON THE TAXONOMY, MORPHOLOGY, AND LIFE CYCLES OF FISH BLADDER FLUKES (TREMATODA: GORGODERIDAE)

Edwin Benzel Steen, Thesis (Ph.D.)
Purdue University, 1938

Two new species of bladder flukes, Phyllodistomum undulans n.sp. from Cottus bairdi, the miller's thumb, and P. brevicecum n.sp. from Umbra limi, the mud minnow, are described. In the waters inhabited by the fishes harboring these flukes, two new species of gorgoderid cyctocercous cercariae, Cercaria musculii n.sp. and C. pisidii n.sp. were found. These cercariae occur in bivalves of the genera Musculium and Pisidium. Ecological and morphological considerations lead the writer to believe that these cercariae are the larvae of phyllodistomes. Efforts to experimentally demonstrate the life cycle resulted negatively.

The history of the genus Phyllodistomum is summarized to date and a key to the species given. Gorgoderina translucida and G. tenua are transferred to this genus. Other species of the genus Gorgoderina are retained provisionally. P. carolini and P. Hunteri are considered valid species. A table of the morphological characters of recently described phyllodistomes is included.

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Part II

CUMULATIVE INDEX

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ART

Later Corinthian pottery. Mary Thorne Campbell, Ph.D. Thesis; Bryn Mawr College, 1941. pp. 234, Pub. No. 797, (M.A. 1946, Vol. VII, No. 1).

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Preparation, purification and refractive index determinations of the methyl, propyl and isopropyl esters of some saturated fatty acids. George William Hunter, Ph.D. Thesis; Pennsylvania State, 1946. pp. 94, Pub. No. 915, (P.S. 1946, Vol. IX).

The relation of molecular size and chemical constitution of saturated petroleum fractions to their insecticidal efficiency. George W. Pearce, Ph.D. Thesis; Pennsylvania State, 1946. pp. 140, Pub. No. 899, (P.S. 1946, Vol. IX).

The effect of certain micronutrient elements on the growth and yield of pineapple plants. Francisco J. Ramirez-Silva, Ph.D. Thesis; Pennsylvania State, 1946. pp. 76, Pub. No. 900, (P.S. 1946, Vol. IX).

BIOLOGICAL CHEMISTRY

The enzymatic dephosphorylation of ribonucleic acid. A study of soy bean nucleases. Max Schlamowitz, Ph.D. Thesis; University of Michigan, 1946. pp. 160, Pub. No. 798, (M.A. 1946, Vol. VII No. 1).

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BOTANY

"White-heads" of grasses. Harry Louis Keil, Ph.D. Thesis; Pennsylvania State, 1946. pp. 39, Pub. No. 895, (P.S. 1946, Vol. IX).

The action of allelic forms of the gene A_1 in maize. John R. Laughnan, Ph.D. Thesis; University of Missouri, 1946. pp. 113, Pub. No. 809, (M.A. 1946, Vol. VII, No. 1).

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BOTANY

Mineral absorption and resistance to wildfire in tobacco. Paul Sacco, Ph.D. Thesis; Pennsylvania State, 1946. pp. 105, Pub. No. 901, (P.S. 1946, Vol. IX).

CHEMICAL ENGINEERING

A. The effect of composition on the oxidation of hydrocarbon oils. B. The catalytic oxidation of Pennsylvania neutral oils. Neal Devere Lawson, Ph.D. Thesis; Pennsylvania State, 1946. pp. 198, Pub. No. 896, (P.S. 1946, Vol. IX).

Some calculations of multicomponent separations. Harold S. Ray, Ph.D. Thesis; Pennsylvania State, 1946. pp. 436, Pub. No. 903, (P.S. 1946, Vol. IX).

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